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ASPHALT PAVEMENT ANALYSIS

OVERVIEW OF MICRO-COMPUTER PROGRAMS

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ASPHALT PAVEMENT ANALYSIS

OVERVIEW OF MICRO-COMPUTER PROGRAMS

by

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Ministry of Transportation of Ontario
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ASPHALT PAVEMENT ANALYSIS
OVERVIEW OF MICROCOMPUTER PROGRAMS

Authors: *R. Raciborski, K.K. Tam, D.F. Lynch*

Abstract:

This report gives a short description and summarizes the capabilities of six interactive computer programs developed for use in highway material and pavement design and analysis.

Four of these programs, namely ELSYM5, NULOAD, ILLI-PAVE Algorithms, and VESYS3AM, were originally written for use on mainframe, and since 1987 are made available by the FHWA in microcomputer versions. BISAR-PC program was developed by SHELL International Petroleum Company Limited. It is an abbreviated version of BISAR. The program was designed in the 1970s for mainframe environment. Also developed by SHELL is a program called BANDS-PC. It is a supportive tool for computing the asphalt cement and asphalt mix stiffness, and also for fatigue life prediction for asphalt mixes.

This study aims at examining and deploying such computer techniques as part of future laboratory evaluation procedures for Ontario conditions.

Each of the programs is presented under a separate section. Along with background information, the program purpose, application and limitations are discussed. Lists of required input data and output data or results are presented. Conclusions regarding possible uses of the programs are included.

Examples of input data and output data files generated by the evaluated programs are given in Appendices A to E. Also included in Appendix D is the program, written in GWBASIC language, which enables interactive data input to be used with the VESYS3AM program on some of IBM PC compatibles (e.g. EPSON EQUITY III+).

Abrégé:

Le présent rapport donne une courte description et un résumé des fonctions que peuvent accomplir six programmes informatiques interactifs utilisés pour l'analyse et la conception de matériaux et de revêtements routiers.

Quatre de ces programmes, soit le ELSYM5, le NULOAD, l'ILLI-PAVE l'Algorithms et le VESYS3AM, ont été initialement conçus pour être utilisés avec un ordinateur central. Depuis 1987, ces programmes sont disponibles auprès de la FHWA en versions adaptées pour les micro-ordinateurs. Le programme BISAR-PC a été mis au point par la SHELL International Petroleum Company Limited. Il s'agit d'une version abrégée du BISAR mise au point dans les années 1970 pour fonctionner avec un ordinateur central. SHELL a également conçu le programme intitulé BANDS-PC utilisé pour le traitement informatique des données relatives à la consistance du ciment asphaltique et des mélanges asphaltiques, ainsi que pour prédire l'endurance de ces mélanges.

L'étude vise à examiner ces techniques informatiques et à en favoriser l'utilisation dans le cadre des procédures futures d'évaluation en laboratoire des conditions routières en Ontario.

Chaque programme est présenté dans une section distincte. En plus d'offrir des renseignements de base, on discute de l'objet, de l'application et des limites des programmes. On présente également des listes de données d'entrée et de données de sortie ou de résultats nécessaires aux programmes. On a également formulé des conclusions sur l'utilisation possible des programmes.

Les annexes A à E présentent des exemples de fichiers de données d'entrée et de données de sortie produits par les programmes évalués. En outre, l'annexe D porte sur le programme écrit en langage GWBASIC, qui permet l'entrée interactive de données à l'aide du programme VESYS3AM utilisé dans certains ordinateurs compatibles IBM PC (p. ex. EPSON EQUITY III+).

Keywords: **Pavement, computer models, asphalt, mix stiffness, fatigue, performance, prediction, life cycle, finite element.**

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1. INTRODUCTION

With advances in microcomputer processing speed, more programs in the field of pavement design and analysis are readily available which require very little special minicomputer or mainframe expertise to operate. This opens new opportunities to pavement evaluation and design professionals. Simple interactive data input routines provide for more control over data handling and result computations. It is especially important in the development of pavement management systems where data flow from field performance testing and from laboratory testing must be frequently verified.

There is a variety of existing programs developed by universities and other pavement research institutions all over the world during the last two decades or so. They vary widely in their application, ranging from strictly theoretical models to quite refined and complex analytical and design methodologies utilizing many stochastic processes.

This study aims at adapting different computer models for use in the laboratory as part of the evaluation procedures for pavement materials.

Four well known programs made available to the public by the FHWA, U.S. Department of Transportation, for use on IBM PC and compatible microcomputers are:

ELSYM5: Determines stresses, strains and displacements in an ideal elastic layered system loaded with one or more identical uniform circular loads.

NULOAD: Evaluates the effect of legal load limit changes on the life cycle costs of flexible, rigid and/or composite pavements.

ILLIPAVE (Algorithms): Designs flexible pavement thicknesses or analyzes existing asphalt pavements using algorithms developed on the basis of the ILLIPAVE finite element structural model.

VESYS3AM: Designs and analyzes a flexible pavement using sets of mechanistic models for computing the pavement distress and performance and thus for predicting the pavement serviceability.

Two other programs, **BISAR-PC** and **BANDS-PC**, were made available for internal use in this Office by Shell International Petroleum Company Limited:

BISAR-PC: Calculates stresses and strains in a pavement model represented by linearly elastic layers. It can be used in conjunction with the "Shell Pavement Design Manual".

BANDS-PC: Calculates the stiffness modulus of bituminous binders and asphalt mixes and also predicts asphalt mix fatigue life in laboratory testing.

All of the programs are used for testing purposes and run on IBM PC compatible microcomputers (EPSON EQUITY III+ and COMPAQ DESKPRO). Interactive data input program has been created for the purpose of test-running the VESYS3AM program.

Program structure, required input data and output of each program are discussed. Also demonstration printouts of program output are presented in the appendices.

A summary of program capabilities and conclusions on the application of programs are made at the end of the report.

2. 'ELSYM5' PROGRAM OVERVIEW

2.1. BACKGROUND

ELSYM5 was developed at the University of California at Berkeley. It is a modification of the LAYER5 program by the same university. It models a 3-dimensional idealized elastic layered pavement system.

Several microcomputer versions of the program (by different universities) have been developed and the present one was developed for the FHWA in 1986 to run on the IBM PC and compatible computers.

The program has the capability to consider multiple loads and the presence of a rigid base below the subgrade. It assumes that:

- each layer is composed of a weightless, homogeneous and isotropic material;
- the material behaves according to Hooke's law;
- each layer is of a uniform thickness and infinite width in all directions;
- the boundaries between the layers are at "full friction", with the exception of the interface between the bottom layer and the rigid base where zero friction can be specified;

- the surface is free of shear;
- the loads applied are identical, vertical and uniform over a circular area;
- the bottom elastic layer is semi-infinite in thickness or is given a finite thickness (i.e. the bottom layer is assumed to be supported by a rigid base).

The principle of superposition is used to determine the response at any given point when the multiple loads are specified.

The program combines three elements:

* interactive input processor for creating or modifying data sets;
* analysis program; and
* interactive output processor for viewing the output on the screen or for saving it in an output file.

2.2. PROGRAM PURPOSE AND LIMITATIONS

The program can determine various component stresses, strains and displacements as well as the principal values in a 3-dimensional elastic layered system, when loaded with one or more identical uniform circular loads normal to the surface of the system.

There are some limitations imposed on the ELSYM5 procedure and in particular, the following:

- the number of elastic layers in the pavement cannot exceed five;
- the number of loads applied to the pavement cannot exceed ten;
- the number of evaluation coordinates is limited to 10 XY coordinate pairs and 10 Z coordinates, for a combined maximum of 100 points;
- all values except for the XY coordinates must be positive.

2.3. REQUIRED INPUT DATA

Layer material properties:

- thickness (inches);
- Poisson's ratio;
- modulus of elasticity (psi).

Load data:

- load defined by any two of the following:

  * force (lb),
  * pressure (psi),
  * radius (inches),

- load location(s) defined by XY coordinates along the surface of the top layer of the pavement.

Evaluation coordinate data:

- locations entered as a series of XY and Z coordinates (a total 100=10*10 evaluation locations are possible); Z is limited to the bottom of the lowest layer in a rigid base pavement.

The program reads a standard ELSYM5 data file as input and assigns its data to internal variables for user modification. An example of input data file is given in Appendix A.

Calculations are usually completed within 1 to 10 minutes and the program automatically branches to the output processor.

2.4. RESULTS (Output File)

Results of computations are presented for each layer (or 'Z' coordinate depth) separately. They comprise normally:

- evaluation coordinate data;
- normal stresses (psi);
- shear stresses (psi);
- principal stresses (psi);
- principal shear stresses (psi);
- displacements (in);
- normal strains;
- shear strains;
- principal strains;
- principal shear strains.

An example of output file is given in the Appendix A.

3. 'NULOAD' PROGRAM OVERVIEW

3.1. BACKGROUND

NULOAD program was developed originally by Austin Research Engineers, Inc., in 1978, for the FHWA. It was written in FORTRAN to run on a mainframe computer. In 1985 the program was converted to run on the IBM PC micro and compatibles.

The program evaluates the effects of increased legal load limits on any given network of highways. "Life cycle" is predicted for each representative structural section (network is divided appropriately into groups) for both present and proposed legal loads, on the basis of fatigue, rutting, and/or PSI. Models from the AASHTO Interim Guide were chosen for this purpose.

Survivor curves are used together with the life cycle calculations to schedule overlays. The symmetrical type of the survivor curve was selected for use in NULOAD. The standard deviation of the curve must be defined by the user.

The effects of vehicle size, weight and configuration are evaluated using the concept of 80 kN equivalent single axle loads. A load equivalency factor is used to assess the destructive effects of increased legal traffic loadings on pavements. Performance equivalency factors and asphalt tensile strain and subgrade vertical strain were related using the AASHTO Road Test axle configurations.

Traffic information comprising truck percentages, weight distribution and growth rate estimate is left to be gathered and prepared by the user of the program.

Three modelling methods are available to NULOAD users for maintenance cost prediction. They are:

- No Maintenance;
- Historical Maintenance;
- Earomar Model.

The last model (Earomar) incorporates, in addition to the work load prediction, the prediction of total costs of the lane occupancy by work crews for the purpose of pavement maintenance activities. The model is intended to be used primarily for freeways. It is discussed in detail in the FHWA report No. FHWA-RD-79-73 entitled "Effect of Changes in Legal Load Limits on Pavement Costs: Volume 1 - Development of Evaluation Procedure", July 1978.

The time factor in engineering economic analyses is considered by using an interest

rate selected by the user. It enables adequate comparison of the effects of legal load limit changes.

3.2. PROGRAM PURPOSE AND LIMITATIONS

The program is for determining the effects of changes in truck size, weight and configuration on pavement performance and to relate these effects to maintenance and rehabilitation costs. Thus, it essentially deals with existing pavement structures for predicting their performance and evaluating the need for pavement strengthening under current and predicted traffic conditions.

The limitations of the program usage lie in the fact that the pavement structure under evaluation must be close enough to AASHTO specifications (related to material properties and thicknesses). Another limitation comes from the spacing between axles or transverse spacing between dual tires; these are expected to be close to that used for the AASHO Road Test. The program employs the AASHTO Interim Guide life prediction models for fatigue, rutting and PSI. If the applicability of the models to a given pavement structure is not known or questionable, the program must be used with caution.

NULOAD is capable of modelling various sizes of highway network, within the following limits:

- max. 10 representative sections can be handled simultaneously;
- max. 10 types of trucks can be considered in the analysis.

3.3. REQUIRED INPUT DATA

Three categories of input data are required:

i) traffic and load survey data;

ii) performance prediction data;

iii) economic cost prediction data.

Traffic information comprises:

- % of each truck type;
- axle arrangement (code);
- weight limits (present and proposed) for each axle type;

- % of empty vehicles in each weight interval;
- growth rate for 80 kN ESAL.

Performance prediction data can be divided into 3 groups:

a) highway network statistics (e.g. age, PSI, terminal PSI);

b) representative designs of section and structure (e.g. lane widths, regional factor, layer thicknesses, material type codes, soil support values);

c) pavements older than terminal serviceability.

Economic cost prediction data include unit costs of granular materials and mixes, unit costs of patching, sealing and other repairs. They must be based either on historical maintenance costs or on the prediction of maintenance spending. Also two very important data items used by NULOAD are the interest rate and the length of the analysis period.

An example of input data file is given in Appendix B.

3.4. RESULTS (Output File)

The analysis which normally takes 5 to 20 minutes to complete (with math coprocessor), produces several pages of results. An example is provided in Appendix B.

The output data are presented in the following sequence:

- run parameters;
- flexible structure characteristics;
- materials characteristics (thickness, structural coefficient, material code);
- performance data (PSI, age);
- age distribution;
- overlay data;
- model maintenance and costs of maintenance in consecutive years;
- maintenance cost for pavements older than terminal serviceability;
- truck types and load limits (present) in specified load intervals;
- empty vehicle weight data;
- cumulative axle distributions for each truck type;

- pavement mileage due for timely overlay in a given analysis year;
- average age at terminal PSI;
- performance table for present regulations, incl. remaining life and overlay cost;
- performance table for proposed regulations, incl. remaining life and overlay cost.

4. 'ILLIPAVE' ALGORITHMS PROGRAM OVERVIEW

4.1. BACKGROUND

The ILLIPAVE algorithms program, developed in 1985-86 by the University of Illinois at Urbana-Champaign, is based on multiple extensive series of runs of original ILLIPAVE program. The ILLIPAVE is a finite element structural model analysis, complex enough to require mainframe computer to run it. ILLIPAVE-based algorithms is much smaller program, which can run on an IBM PC and compatibles. The simplified response algorithms formulated by the University are supposed to be accurate enough within the range tested to be included in any "mechanistic" pavement design procedure.

The mainframe program assumes that the pavement is an axisymmetric solid of revolution, composed of granular materials characterized by non-linear, stress-dependent resilient modulus. The Mohr-Coulomb theory of failure is used to define failure criteria. The ILLIPAVE approach enabled developing the flexible pavement overlay design procedure and many other procedures. It is cited as one of the successful computational techniques.

The analysis model in ILLIPAVE is based on a circular load (9000 lb, 80 psi pressure) representing one dual-wheel single axle load (18000 lb). 96 pavement configurations (i.e. layered structures) were analyzed to develop the ILLIPAVE algorithms.

4.2. PROGRAM PURPOSE AND LIMITATIONS

The ILLIPAVE algorithms are designed to help in preliminary design and analysis of asphalt pavements. Solutions can be obtained for:

- asphalt strain at the bottom layer;
- deviator stress at top of subgrade;

- subgrade deviator stress/unconfined compressive strength ratio;
- vertical strain at top of subgrade;
- surface deflection at point of loading;
- subgrade deflection under the point of loading;
- deflection area;
- "breakpoint" resilient modulus of the subgrade.

The use of algorithms is limited to, or may be considered accurate within the following limits:

- asphalt concrete thickness: 0 to 20 cm;
- granular base thickness: 10 to 45 cm, (crushed stone only);
- subgrade moduli/strength: 4 levels i.e. stiff, medium, soft, very soft;
- asphalt concrete modulus: 4 levels i.e. 2000, 1000, 500, 200 ksi.

In order to develop a complete pavement design procedure, it is necessary to evaluate and include in the analysis all the factors related to climate, traffic and other local conditions.

4.3. REQUIRED INPUT DATA

Depending on the number of algorithms utilized for preliminary design or analysis of a pavement, some or all of the following input data may be required:

* thicknesses of all pavement layers;
* resilient modulus of the asphalt layer;
* "breakpoint" resilient modulus of the subgrade;
* surface deflection at the point of loading;
* deflection basin area.

4.4. RESULTS

Solutions of all of the algorithms are presented as single values, as shown in Appendix C.

5. 'VESYS3AM' PROGRAM OVERVIEW

5.1. BACKGROUND

The overall framework of the program was developed originally at the Massachusetts Institute of Technology under FHWA contract. VESYS3AM is a modified version of VESYS3A, prepared earlier by Austin Research Engineers for the FHWA. It is based on several existing versions of the VESYS2M. It is claimed that to date the program presents one of the most advanced mechanistic concepts for the analysis and design of flexible pavements.

The program can handle up to 7-layer pavement system, predicting its behaviour over time by sets of mechanistic models. Pavement distress in terms of rutting, roughness, and crack damage is computed on the basis of a primary response information (probabilistic solution of the stress, strain and deflection at prescribed positions in the pavement system). The program includes the capabilities for seasonal characterizations of pavement materials, low temperature cracking predictions, and a discretized representation of axle load distribution. Cylindrical coordinates are used in computation of stresses, strains and deflections.

Results of the analysis are used in the final stage of the program execution for pavement serviceability predictions.

Three types of program runs are made available:

<1> analysis of primary response, damage and performance;

<2> analysis of primary response only;

<3> analysis of damage and performance only.

In a long range perspective the procedure similar to that used in the program could eventually be implemented as integral part of highway design and pavement management system.

5.2. PROGRAM PURPOSE AND LIMITATIONS

The purpose of the program is to predict the structural response of flexible pavement and evaluate its structural integrity for use in the design procedure. The structural adequacy of the pavement is given in probabilistic terms of the AASHTO Serviceability Index, i.e. takes into account the inaccuracies in predicting traffic, testing materials and forecasting climatic conditions.

The user of the program must still make the final decision regarding his satisfaction with the prediction of pavement serviceability when related to, imposed by others or naturally occuring constraints.

Although the potential of a rational analysis and design of pavements provided by the program seems to be great, it is not easy to come to a fully reliable solution; especially when material testing programs are not complete (because of cost/time factors) or poorly designed. A very good understanding of the program structure is necessary for proper utilization of the program output. And even more in-depth knowledge of material characterization and mechanism of pavement distresses is needed for the user to provide all the required input information.

On the other hand, full field verification of the design procedure is necessary before any routine use of the program is introduced in normal highway operation and administration.

5.3. REQUIRED INPUT DATA

5.3.1. General

* Time span over which the analysis is to be conducted,
* Time units (days, months, years...),
* Number of points in time when distress and performance data are desired (max. 25 points),
* Times at which a printout of the values computed in the damage model is desired.

5.3.2. Data on Traffic

* Average Daily Traffic for each time increment,
* Heavy trucks in the traffic stream, %,
* Heavy trucks in the design lane for each time increment, %,
* Seasonal traffic multipliers to allow for variation in traffic by season,
* The mean and variance of the:
    - axle weight distributions for axles >45.4 kN;
    - intensity of repeated loadings
* The mean duration of repeated axle loadings,

* The radius of a circular area equivalent to the loaded area (to be used in static solution),

* Fractional distribution of axle loadings by weight category (if different categories are specified).

5.3.3. Data on System Geometry

* Number and thickness of layers,

* Radial values of applied loadings to be analyzed,

* Number of load radius values for which static solutions are desired (max.12).

5.3.4. Environmental Data

* Subgrade type,

* Number of time intervals (seasons) within a year,

* Season lengths (months),

* Mean pavement temperatures in the middle of the top pavement layer (for each time interval),

* The winter design temperature for low temperature cracking.

5.3.5. Data on Material Properties

* Poisson's ratio of all pavement layers,

* Mean values of elastic moduli for the n^{th} layer, corresponding to each time interval (season),

* Coefficients of variation in pavement layer moduli,

* Asphalt stiffness at the winter design temperature.

* Flexural fatigue testing data:

    - parameters K1 and K2 in Miner's fatigue formulation,

    - coefficient of variation of the parameters K1 and K2,

    - correlation coefficient for the parameters K1 and K2.

* Creep compliance test data:

    - strain amplitude measured at 200th cycle of the test (in dynamic series only),

    - the slope of the best-fit straight line for accumulated strain vs number

of load cycles (dynamic series), or incremental time of loading (static series),

- intercept of the best-fit straight line (either dynamic or static),
- numbers of load repetitions at which the permanent deformation properties are computed.

5.3.6. Data on System Properties

* Coefficient B used in the system's spacial autocorrelation function,
* Coefficient C in the system's spacial autocorrelation function (pavement roughness).

5.3.7. Data on System Performance Bounds

* Mean value of the PSI distribution at the start of repeated load analysis,
* The standard deviation of the initial PSI,
* The level of unacceptable PSI (or the upper bound on the failure state),
* Minimum acceptable reliability of the pavement (probability that PSI has not reached failure at or before some given time), %.

5.3.8. Data on Output Positions

* Vertical positions at which primary response information is desired,
* Number of Z points of interest (max.20),
* Number of radial points of interest (max.20),
* Depth at which strain for calculation of cracking index is taken,
* Radial distances from the center of the load.

5.4. RESULTS (Output File)

TYPE 1 analysis produces predictions of pavement response and expected lifetime on the basis of system geometry, materials characteristics, environment and imposed performance bounds. Primary response (static load analysis) information is passed to the damage model. Serviceability predictions are then made.

TYPE 2 analysis produces the primary response calculations only, i.e.:

- values for stresses (vertical, tangential, radial, shear),

- values for displacements (vertical, radial),
- values for strains (radial, tangential),

in an N-layered linear visco-elastic system. The points at which response is given are specified in cylindrical coordinates.

TYPE 3 analysis (damage and performance analysis) uses primary response information computed in Type 1 analysis.

Damage analysis produces the following values (for predetermined time intervals):

- fatigue cracking index;
- low temperature cracking index;
- area cracked;
- rut depth;
- slope variance.

Performance analysis produces serviceability values expected at predetermined time intervals and related reliability of the pavement system (expected life).

An example of both the results of analysis and input data is presented in Appendix D.

6. 'BISAR-PC' PROGRAM OVERVIEW

6.1. BACKGROUND

Shell Research developed BISAR program in the 1970s in a mainframe version and used it for research purposes, and primarily in the drafting of the many design charts for the "Shell Pavement Design Manual". That original BISAR can deal with practically unlimited number of pavement layers and loads, with horizontal forces and slippage of pavement layers, and gives results of both normal and shear stresses and displacements.

BISAR-PC program is a simplified calculating tool designed for use with appropriate material characterizations and failure criteria, such as given in the Shell Manual mentioned above.

The pavement model - as adopted in the program - is a system of homogeneous layers of infinite horizontal extent, resting on a semi-infinite subgrade. The response of the layers to loading is that of linearly elastic solids.

Loading from the traffic is considered as a uniform normal stress over one or more circular areas on the surface of pavement.

6.2. PROGRAM PURPOSE AND LIMITATIONS

The program was introduced by Shell as a calculating tool in asphalt pavement design. Its role is to help the designer in refining his design based on specific material properties and loading patterns.

Major limitations imposed on computing capability of the microcomputer version of the program are as follows:

- it does not deal with horizontal forces and slippage between pavement layers;
- it does not calculate pavement deflections;
- the maximum number of pavement layers - four;
- the maximum number of circular loads - four;
- the maximum number of positions (where stresses and strains are calculated) - ten;
- results are limited to the maximum tensile and compressive stresses and strains in the selected positions.

Typical computing run can take several minutes.

6.3. REQUIRED INPUT DATA

The folowing parameters can be specified as input for calculations of stresses and strains:

a) General

- the number of layers,
- the number of loading points and their coordinates on pavement surface,
- the number of positions for stress and strain calculations and their coordinates,

- thickness of the layers, m.

b) Load

- vertical wheel load, kN,
- the wheel vertical contact stress, kPa,
- radius of the loaded area, m.

c) Materials

- the Poisson's ratio (for all layers),
- the modulus of elasticity, MPa.

If the Poisson's ratio value is not specified by the user then its value is defaulted to 0.35.

6.4. RESULTS OF CALCULATIONS (OUTPUT)

The output of the BISAR-PC consists of the coordinates of positions and the results of calculations for the specified positions. The results are:

- maximum horizontal and vertical stresses, MPa;
- maximum horizontal and vertical strains, μm/m.

They are presented in a table of blocks, where one block represents a single "system", i.e. the actual configuration of layers, loads and positions.

The results can be stored in the output file. This file can be browsed on-screen and hard copy of all or selected part of the results can be printed.

The format of the output is shown in Appendix E.

7. 'BANDS-PC' PROGRAM OVERVIEW

7.1. BACKGROUND

This program is a computerized version of the well-known nomographs developed by Shell to determine:

- the asphalt cement stiffness ("Van der Poel nomograph");

- the asphalt mix stiffness ("Ugé nomograph");
- the asphalt mix fatigue life.

It is important to note that the program is a prediction tool only. Its results do not represent the actual testing results.

The formulas used in calculating the parameters are based on the investigation of a limited number of binder and asphalt mix types. Also testing conditions were limited in scope. Although the program offers a very fast and easy access to the parameters, some restrictions on using them must be excercised when dealing with non-standard materials like waxy bitumens, recycled mixes or mixes with special additives. A basic knowledge in the fields of materials engineering and pavement design is necessary for using the predictions of the program.

7.2. REQUIRED INPUT DATA

7.2.1. ASPHALT CEMENT STIFFNESS

To obtain prediction of the stiffness, the following parameters must be entered prior to computing:

- time of loading, s;
- asphalt cement temperature, °C;

and one of the folowing three combinations of characteristics:

-- Softening Point T800 pen + Penetration Index;

-- Softening Point T800 pen + penetration value and temperature;

-- Two penetration values and corresponding temperatures (°C).

7.2.2. ASPHALT MIX STIFFNESS

Prediction of the asphalt mix stiffness is based on the input of:

- asphalt cement stiffness, MPa;
- the content of asphalt cement in the mix, %vol.;
- the content of mineral aggregate in the mix, %vol.

7.2.3. FATIGUE LIFE OF ASPHALT MIXES

Required input parameters are:

- asphalt mix stiffness, MPa;
- asphalt cement content, %vol.

7.3. RESULTS (PREDICTED VALUES)

The program predicts the values of:

- asphalt cement stiffness, MPa;
- asphalt mix stiffness, MPa;
- voids in asphalt mix, %;
- fatigue life of the mix in terms of the number of loading cycles, or the initial bending strain, μm/m, at pre-set number of loading cycles.

The fatigue life here refers to the predicted life of a mix under a laboratory accelerated test. It should not be considered as being able to relate directly to pavement life.

Examples of typical input and output formats are given in Appendix F.

8. CONCLUSIONS

a) *ELSYM5* program gives a theoretical solution to an idealized elastic layered pavement system. It can be considered a useful tool for initial analysis of pavement response to loading.

b) *NULOAD* is a highway pavement network-oriented analysis program referring heavily to the AASHO Road Test results. It could be helpful in estimating the effects of major changes in load limits and traffic patterns on a highway network, and especially on its maintenance costs.

c) *ILLIPAVE* Algorithms are derived from full-blown finite-element structural model analysis (ILLIPAVE). The Algorithms program, due to its simplicity, has a good potential in producing the types of strains and stresses that are essential in the design and analysis of asphalt pavements.

d) *VESYS3AM* is the most comprehensive pavement analysis program based on mechanistic concepts, making the fullest use of laboratory material testing results. Pavement distress models are built on a wide basis of laboratory evaluation of pavement materials. Structural adequacy of the pavement is evaluated in probabilistic terms. The program could be a very useful element in a pavement management system. However, it requires of the user full awareness of the many important factors for making appropriate decisions. As well, it requires extensive experience in the interpretation of laboratory test results.

e) *BISAR-PC* program provides the calculation of theoretical responses of elastic pavement layers to various loads in terms of maximum horizontal and vertical stresses and strains. *BANDS-PC* program gives the capability of accurate calculating the asphalt cement and asphalt mix stiffness and fatigue life. Both of these programs are useful to studying material characteristics and pavement performance.

9. RECOMMENDATIONS

a) Select appropriate sites and test run the programs.

b) Compare predicted patterns to actual developments.

c) Integrate the programs into the evaluation system under development in the Bituminous Evaluation Laboratory.

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APPENDIX A

ELSYM5: INPUT/OUTPUT

(EXAMPLE)

ELSYM5: MAIN MENU and DATA ENTRY OPTIONS

```
-ELSYM5-
Interactive Input Processor
Version 1.0, Released 10/85
Developed by
SSA Technologies, Inc.

Under contract to
Federal Highway Administration

MAIN MENU

1. Instructions
2. Create a New Data File
3. Modify an Existing Data File
4. Perform Analysis
5. Exit - Return to DOS

Selection:
```

```
Create a New Data File Menu

1. Enter/Modify Run Title

2. Enter/Modify Elastic Layer Data

3. Enter/Modify Load Data

4. Enter/Modify Evaluation Location Data

5. Write Data to an Output File

6. Return to Main Menu

Selection:
```

```
Modify an Existing Data File Menu

1. Modify Run Title

2. Modify Elastic Layer Data

3. Modify Load Data

4. Modify Evaluation Location Data

5. Read one Data Set from an Input File

6. Write Data to an Output File

7. Return to Main Menu

Selection:
```

I N P U T

ELASTIC SYSTEM - Example 1

LAYER	ELASTIC MODULUS	POISSONS RATIO	THICKNESS	
1	2800000.	.320	7.000 IN	
2	80000.	.400	5.500 IN	
3	7500.	.220	10.000 IN	RIGID BASE, FULL FRICT.

THREE LOAD(S), EACH LOAD AS FOLLOWS

TOTAL LOAD..... 4800.00 LBS
LOAD STRESS.... 85.00 PSI
LOAD RADIUS.... 4.24 IN

LOAD	LOCATED AT X	Y
1	.000	.000
2	12.000	5.000
3	20.000	10.000

RESULTS REQUESTED FOR SYSTEM LOCATION(S)

DEPTH(S)
Z= .00 4.00 8.00 12.00

X-Y POINT(S)

X	Y
.00	.00
4.50	.00
10.00	.00
15.00	.00

O U T P U T

Z= .00 LAYER NO, 1

X	Y
.00	.00
4.50	.00
10.00	.00
15.00	.00

NORMAL STRESSES

SXX	-.1787E+03	-.1049E+03	-.1341E+03	-.1296E+03
SYY	-.2075E+03	-.1579E+03	-.1369E+03	-.1268E+03
SZZ	-.8482E+02	.3682E+01	.1610E+01	-.1878E+01

SHEAR STRESSES

SXY	.1653E+02	.2050E+02	.2117E+02	-.2022E+01
SXZ	-.1566E-05	.1963E-04	.3034E-05	-.1603E-04
SYZ	-.1233E-05	.8474E-05	.1301E-04	.3196E-05

PRINCIPAL STRESSES

PS 1	-.8482E+02	.3682E+01	.1610E+01	-.1878E+01
PS 2	-.1712E+03	-.9791E+02	-.1143E+03	-.1257E+03
PS 3	-.2150E+03	-.1649E+03	-.1567E+03	-.1306E+03

PRINCIPAL SHEAR STRESSES

PSS 1	.6511E+02	.8428E+02	.7916E+02	.6438E+02
PSS 2	.4319E+02	.5080E+02	.5794E+02	.6192E+02
PSS 3	.2192E+02	.3348E+02	.2122E+02	.2454E+01

DISPLACEMENTS

UX	.2947E-03	.1506E-03	.9101E-05	-.1627E-03
UY	.1346E-03	.1737E-03	.2343E-03	.2544E-03
UZ	.4675E-02	.4954E-02	.5166E-02	.5072E-02

NORMAL STRAINS

EXX	-.3042E-04	-.1985E-04	-.3242E-04	-.3157E-04
EYY	-.4399E-04	-.4481E-04	-.3376E-04	-.3026E-04
EZZ	.1385E-04	.3135E-04	.3154E-04	.2863E-04

SHEAR STRAINS

EXY	.1558E-04	.1933E-04	.1996E-04	-.1907E-05
EXZ	-.1477E-11	.1851E-10	.2860E-11	-.1512E-10
EYZ	-.1162E-11	.7990E-11	.1227E-10	.3014E-11

PRINCIPAL STRAINS

PE 1	.1385E-04	.3135E-04	.3154E-04	.2863E-04
PE 2	-.2687E-04	-.1655E-04	-.2309E-04	-.2976E-04
PE 3	-.4754E-04	-.4812E-04	-.4309E-04	-.3207E-04

PRINCIPAL SHEAR STRAINS

PSE 1	.6139E-04	.7946E-04	.7463E-04	.6070E-04
PSE 2	.4072E-04	.4789E-04	.5463E-04	.5838E-04
PSE 3	.2066E-04	.3157E-04	.2000E-04	.2313E-05

Z= 4.00 LAYER NO, 1

X	Y
.00	.00
4.50	.00
10.00	.00
15.00	.00

NORMAL STRESSES

SXX	.1246E+02	.8071E+01	.1362E+02	.1371E+02
SYY	.1708E+02	.1907E+02	.1288E+02	.1042E+02
SZZ	-.3917E+02	-.1641E+02	-.1023E+02	-.7855E+01

SHEAR STRESSES

SXY	-.2600E+01	-.4363E+01	-.4912E+01	.1962E+01
SXZ	.1212E+02	-.9737E+01	.2052E+01	-.1520E+02
SYZ	.5335E+01	.1155E+02	.3005E+02	.3166E+02

PRINCIPAL STRESSES

PS 1	.1825E+02	.2552E+02	.3394E+02	.3700E+02
PS 2	.1456E+02	.7301E+01	.1365E+02	.1463E+02
PS 3	-.4243E+02	-.2209E+02	-.3131E+02	-.3535E+02

PRINCIPAL SHEAR STRESSES

PSS 1	.3034E+02	.2380E+02	.3263E+02	.3617E+02
PSS 2	.1845E+01	.9109E+01	.1014E+02	.1118E+02
PSS 3	.2850E+02	.1470E+02	.2248E+02	.2499E+02

DISPLACEMENTS

UX	-.3931E-04	-.1418E-04	-.1879E-05	.2517E-04
UY	-.1788E-04	-.2496E-04	-.3941E-04	-.4250E-04
UZ	.4649E-02	.4988E-02	.5216E-02	.5121E-02

NORMAL STRAINS

EXX	.6976E-05	.2579E-05	.4561E-05	.4606E-05
EYY	.9152E-05	.7762E-05	.4214E-05	.3050E-05
EZZ	-.1737E-04	-.8961E-05	-.6683E-05	-.5563E-05

SHEAR STRAINS

EXY	-.2452E-05	-.4114E-05	-.4631E-05	.1850E-05
EXZ	.1143E-04	-.9180E-05	.1934E-05	-.1433E-04
EYZ	.5030E-05	.1089E-04	.2833E-04	.2985E-04

PRINCIPAL STRAINS

PE 1	.9703E-05	.1080E-04	.1414E-04	.1558E-04
PE 2	.7963E-05	.2216E-05	.4575E-05	.5036E-05
PE 3	-.1890E-04	-.1164E-04	-.1662E-04	-.1852E-04

PRINCIPAL SHEAR STRAINS

PSE 1	.2861E-04	.2244E-04	.3076E-04	.3411E-04
PSE 2	.1740E-05	.8588E-05	.9564E-05	.1055E-04
PSE 3	.2687E-04	.1386E-04	.2120E-04	.2356E-04

Z= 8.00 LAYER NO, 2

X	Y
.00	.00
4.50	.00
10.00	.00
15.00	.00

NORMAL STRESSES

SXX	.1109E+01	.1271E+01	.1512E+01	.1420E+01
SYY	.1908E+01	.2043E+01	.1843E+01	.1486E+01
SZZ	-.5265E+01	-.5213E+01	-.5208E+01	-.4973E+01

SHEAR STRESSES

SXY	-.4609E+00	-.5497E+00	-.4445E+00	-.6559E-01
SXZ	.1367E+01	.4697E+00	-.5221E-01	-.9951E+00
SYZ	.6091E+00	.1023E+01	.1721E+01	.1971E+01

PRINCIPAL STRESSES

PS 1	.2119E+01	.2396E+01	.2451E+01	.2205E+01
PS 2	.1243E+01	.1103E+01	.1302E+01	.1380E+01
PS 3	-.5610E+01	-.5398E+01	-.5606E+01	-.5653E+01

PRINCIPAL SHEAR STRESSES

PSS 1	.3864E+01	.3897E+01	.4028E+01	.3929E+01
PSS 2	.4380E+00	.6467E+00	.5747E+00	.4121E+00
PSS 3	.3426E+01	.3250E+01	.3454E+01	.3517E+01

DISPLACEMENTS

UX	-.3295E-03	-.1848E-03	-.8814E-05	.1751E-03
UY	-.1508E-03	-.1906E-03	-.2449E-03	-.2673E-03
UZ	.4493E-02	.4844E-02	.5076E-02	.4992E-02

NORMAL STRAINS

EXX	.3065E-04	.3173E-04	.3573E-04	.3519E-04
EYY	.4463E-04	.4525E-04	.4151E-04	.3634E-04
EZZ	-.8090E-04	-.8173E-04	-.8188E-04	-.7670E-04

SHEAR STRAINS

EXY	-.1613E-04	-.1924E-04	-.1556E-04	-.2296E-05
EXZ	.4784E-04	.1644E-04	-.1827E-05	-.3483E-04
EYZ	.2132E-04	.3580E-04	.6022E-04	.6899E-04

PRINCIPAL STRAINS

PE 1	.4832E-04	.5143E-04	.5216E-04	.4892E-04
PE 2	.3299E-04	.2879E-04	.3204E-04	.3450E-04
PE 3	-.8692E-04	-.8497E-04	-.8884E-04	-.8858E-04

PRINCIPAL SHEAR STRAINS

PSE 1	.1352E-03	.1364E-03	.1410E-03	.1375E-03
PSE 2	.1533E-04	.2264E-04	.2011E-04	.1442E-04
PSE 3	.1199E-03	.1138E-03	.1209E-03	.1231E-03

Z= 12.00 **LAYER NO, 2**

X	Y
.00	.00
4.50	.00
10.00	.00
15.00	.00

NORMAL STRESSES

SXX	.3966E+01	.4717E+01	.5100E+01	.4751E+01
SYY	.5024E+01	.5478E+01	.5506E+01	.5018E+01
SZZ	-.3725E+01	-.4002E+01	-.4183E+01	-.4109E+01

SHEAR STRESSES

SXY	-.6206E+00	-.6434E+00	-.4815E+00	-.1326E+00
SXZ	.4665E+00	.2243E+00	-.8676E-02	-.2896E+00
SYZ	.2103E+00	.3106E+00	.4604E+00	.5234E+00

PRINCIPAL STRESSES

PS 1	.5310E+01	.5848E+01	.5841E+01	.5111E+01
PS 2	.3715E+01	.4364E+01	.4787E+01	.4697E+01
PS 3	-.3760E+01	-.4019E+01	-.4205E+01	-.4148E+01

PRINCIPAL SHEAR STRESSES

PSS 1	.4535E+01	.4933E+01	.5023E+01	.4630E+01
PSS 2	.7979E+00	.7417E+00	.5267E+00	.2073E+00
PSS 3	.3737E+01	.4192E+01	.4496E+01	.4423E+01

DISPLACEMENTS

UX	-.5288E-03	-.3115E-03	-.1971E-04	.2666E-03
UY	-.2429E-03	-.2928E-03	-.3549E-03	-.3817E-03
UZ	.4161E-02	.4487E-02	.4709E-02	.4644E-02

NORMAL STRAINS

EXX	.4308E-04	.5158E-04	.5714E-04	.5484E-04
EYY	.6159E-04	.6491E-04	.6424E-04	.5952E-04
EZZ	-.9151E-04	-.1010E-03	-.1053E-03	-.1002E-03

SHEAR STRAINS

EXY	-.2172E-04	-.2252E-04	-.1685E-04	-.4642E-05
EXZ	.1633E-04	.7850E-05	-.3037E-06	-.1014E-04
EYZ	.7361E-05	.1087E-04	.1611E-04	.1832E-04

PRINCIPAL STRAINS

PE 1	.6661E-04	.7137E-04	.7010E-04	.6115E-04
PE 2	.3368E-04	.4541E-04	.5166E-04	.5389E-04
PE 3	-.9212E-04	-.1013E-03	-.1057E-03	-.1009E-03

PRINCIPAL SHEAR STRAINS

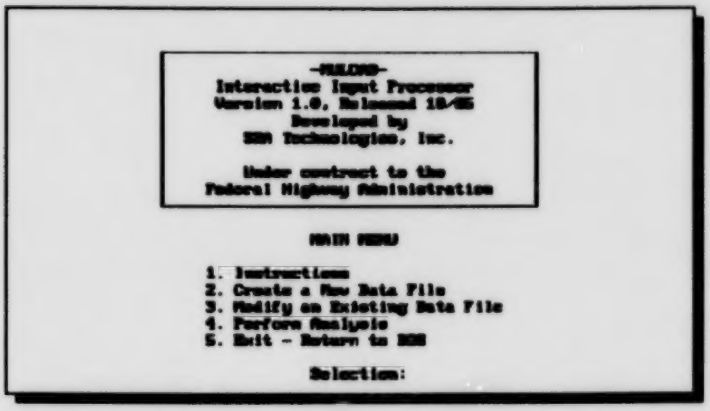
PSE 1	.1587E-03	.1727E-03	.1758E-03	.1620E-03
PSE 2	.2793E-04	.2596E-04	.1843E-04	.7255E-05
PSE 3	.1308E-03	.1467E-03	.1574E-03	.1548E-03

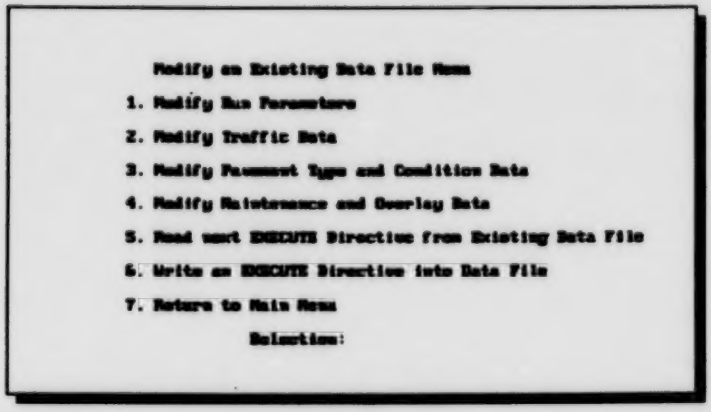
APPENDIX B

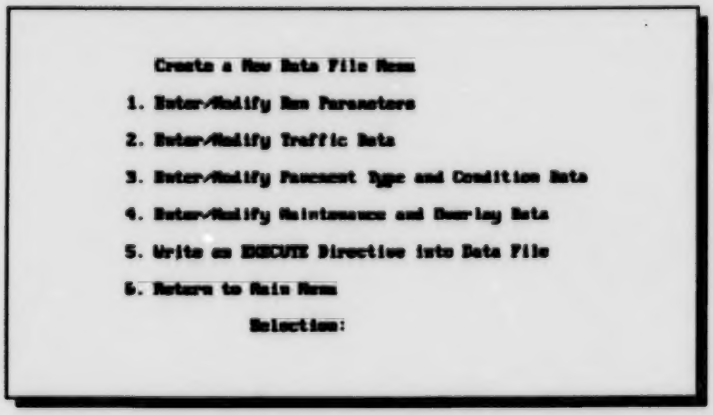
NULOAD: INPUT/OUTPUT

(EXAMPLE)

NULOAD: MAIN MENU and DATA ENTRY OPTIONS




Modify an Existing Data File Menu
1. Modify Run Parameters
2. Modify Traffic Data
3. Modify Pavement Type and Condition Data
4. Modify Maintenance and Overlay Data
5. Read next EXECUTE Directive from Existing Data File
6. Write an EXECUTE Directive into Data File
7. Return to Main Menu
Selection:


Create a New Data File Menu
1. Enter/Modify Run Parameters
2. Enter/Modify Traffic Data
3. Enter/Modify Pavement Type and Condition Data
4. Enter/Modify Maintenance and Overlay Data
5. Write an EXECUTE Directive into Data File
6. Return to Main Menu
Selection:

AUSTIN RESEARCH ENGINEERS INC

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

I N P U T
(FLEXIBLE PAVEMENT)

```
RUN PARAMETERS          20    0      2.00        6.00         .00         .00         .00
SYSTEM TITLE             0    0       .00         .00         .00         .00         .00

SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

FLEXIBLE                 0    0     12.00        5.50        2.00         .00         .00

INTFLX A  INTERSTATE SYSTEM FLEXIBLE SECTION *A*

ACP    6.0 .440 ATB    4.0 .340 AGS    6.0 .110          .0 .000

AGE DISTRIBUTION        25    1      1.40         .00         .00         .00         .00
   107.0    87.0   110.0   118.0   118.0    87.0    78.0    65.0    80.0    50.0   48.0   28.0   17.0   22.0   17.0
    10.0    17.0    13.0    10.0     7.0     2.0     3.0     3.0     2.0     2.0
    287.00   270.00   264.00   251.00   182.00   159.00   146.00   134.00
    114.00   102.00    94.00    89.00    83.00    77.00    72.00    67.00
     63.00    59.00    55.00    51.00    48.00    45.00    42.00    39.00
     36.00
      3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00
      3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00
      3.00     3.00     3.00     3.00     3.00     3.00     3.00     3.00
      3.00
PERFORMANCE              0    0      4.20        2.50        4.20       20.00         .00
     14.00    11.50    16.00
MODEL MAINT              1    0       .00         .00         .00         .00         .00
      1.45      .06     9.40
     10.30      .00      .00        .20      20.00      .04    7
OVERLAY                  2    3       .00         .00         .00         .00         .00
     95.00     7.00     5.00       25.00        .35        .00        .00
OLD SECTIONS             1    0   1500.00       10.00         .00         .00         .00
OUTPUT                   3    0       .00         .00         .00         .00         .00
TRUCK TYPE               4    0       .00         .00         .00         .00         .00
2D          3A          3-S2          2-S1-2
 1 0 0 0   0 1 0 0   0 2 0 0   4 0 0 0
  1   3.75   .93 12.43   .57   .00   .00   .00   .00   .00   .00 17.68
  2   3.81   .93 12.51   .57   .00   .00   .00   .00   .00   .00 17.82
  3   3.92   .93 12.60   .57   .00   .00   .00   .00   .00   .00 18.01
  4   3.96   .92 12.68   .57   .00   .00   .00   .00   .00   .00 18.13
  5   4.04   .92 12.77   .57   .00   .00   .00   .00   .00   .00 18.30
  6   4.10   .92 12.75   .57   .00   .00   .00   .00   .00   .00 18.34
```

7	4.14	.92	12.83	.57	.00	.00	.00	.00	.00	.00	18.46		
8	4.21	.91	12.81	.57	.00	.00	.00	.00	.00	.00	18.39		
9	4.25	.91	12.89	.57	.00	.00	.00	.00	.00	.00	18.62		
10	4.31	.91	12.87	.58	.00	.00	.00	.00	.00	.00	18.67		
11	4.35	.91	12.86	.58	.00	.00	.00	.00	.00	.00	18.70		
12	4.41	.90	12.85	.58	.00	.00	.00	.00	.00	.00	18.74		
13	4.45	.90	12.83	.58	.00	.00	.00	.00	.00	.00	18.76		
14	4.48	.90	12.81	.58	.00	.00	.00	.00	.00	.00	18.77		
15	4.52	.90	12.79	.58	.00	.00	.00	.00	.00	.00	18.79		
16	4.58	.89	12.77	.58	.00	.00	.00	.00	.00	.00	18.82		
17	4.63	.89	12.76	.58	.00	.00	.00	.00	.00	.00	18.85		
18	4.67	.89	12.74	.58	.00	.00	.00	.00	.00	.00	18.89		
19	4.69	.89	12.72	.58	.00	.00	.00	.00	.00	.00	18.89		
20	4.73	.88	12.70	.58	.00	.00	.00	.00	.00	.00	18.90		
LOAD LIMITS				1	0	.00		.00		.00		.00	.00
	80.00		18.00		32.00	56.00							
	120.00		20.00		34.00	58.00							
	13.	13.		12.	8.								
	16.	16.		16.	16.								
	.00	.00		.50	.75								
SINGLE AXLES				13	0	.00		.00		.00		.00	.00
	3.	12.		0.	0.	0.							
	7.	169.		5.	0.	37.							
	8.	29.		7.	0.	13.							
	12.	50.		19.	0.	89.							
	16.	25.		2.	0.	62.							
	18.	9.		2.	0.	9.							
	19.	0.		0.	0.	2.							
	20.	0.		0.	0.	1.							
	22.	0.		0.	0.	1.							
	24.	0.		0.	0.	1.							
	26.	0.		0.	0.	0.							
	30.	0.		0.	0.	0.							
	35.	0.		0.	0.	0.							
TANDEM AXLES				16	0	4.00		.00		.00		.00	.00
	6.	0.		0.	68.	0.							
	12.	0.		18.	249.	0.							
	18.	0.		6.	110.	0.							
	24.	0.		3.	160.	0.							
	30.	0.		2.	148.	0.							
	32.	0.		0.	22.	0.							
	33.	0.		2.	6.	0.							
	34.	0.		1.	3.	0.							
	36.	0.		1.	4.	0.							
	38.	0.		2.	1.	0.							
	40.	0.		0.	3.	0.							
	42.	0.		0.	1.	0.							
	44.	0.		0.	0.	0.							
	46.	0.		0.	0.	0.							
	50.	0.		0.	0.	0.							
	55.	0.		0.	0.	0.							
GVW				23	0	8.00		.00		.00		.00	.00
	10.	125.		0.	0.	0.							
	14.	110.		1.	0.	0.							
	20.	132.		13.	4.	0.							
	22.	28.		5.	16.	0.							

	24.	15.	1.	46.	0.				
	26.	14.	2.	39.	1.				
	28.	5.	3.	23.	1.				
	30.	7.	0.	16.	0.				
	32.	2.	2.	15.	2.				
	34.	1.	0.	8.	0.				
	36.	2.	2.	12.	1.				
	38.	0.	1.	10.	0.				
	40.	1.	2.	6.	2.				
	45.	0.	1.	12.	1.				
	50.	0.	3.	27.	2.				
	55.	0.	1.	33.	5.				
	60.	0.	0.	58.	10.				
	65.	0.	0.	34.	6.				
	70.	0.	0.	22.	4.				
	72.	0.	0.	0.	0.				
	75.	0.	0.	1.	0.				
	80.	0.	0.	5.	0.				
	85.	0.	0.	1.	0.				
EMPTY			13	0	4.00	.00	.00	.00	.00
	6.	14.	0.	0.	0.				
	8.	78.	0.	0.	0.				
	10.	143.	4.	0.	0.				
	12.	107.	10.	0.	0.				
	14.	75.	26.	0.	0.				
	16.	50.	47.	2.	0.				
	18.	9.	35.	4.	0.				
	20.	7.	14.	19.	0.				
	25.	4.	23.	290.	3.				
	30.	0.	6.	262.	10.				
	35.	0.	0.	120.	4.				
	40.	0.	0.	24.	0.				
	45.	0.	0.	4.	2.				
EXECUTE			0	0	.00	.00	.00	.00	.00

OUTPUT
(FLEXIBLE PAVEMENT)

SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

RUN PARAMETERS

LENGTH OF ANALYSIS PERIOD	20 YEARS
ANNUAL GROWTH RATE OF 18 KIP EAL	2.00 PERCENT/YEAR
ANNUAL INTEREST RATE FOR PRESENT WORTH CALCULATIONS	6.00 PERCENT/YEAR

NUMBER OF 18-KIP ESAL UNDER PROPOSED REGULATIONS
DERIVED FROM 18-KIP ESAL UNDER PRESENT REGULATIONS
AND THE ASSUMPTION OF EQUAL PAYLOAD

FLEXIBLE STRUCTURE

NUMBER OF LAYERS	3
LANE WIDTH	12.00 FEET
DESIGN SOIL SUPPORT	5.50
REGIONAL FACTOR	2.00

MATERIALS

LAYER NUMBER	THICKNESS (IN.)	STRUCTURAL COEFFICIENT	MATERIAL CODE	
1	6.00	.440	ACP	ASPHALT SURFACE
2	4.00	.340	ATB	ASPHALT BASE
3	6.00	.110	AGS	AGGREGATE SUBBASE

PERFORMANCE

PSI INITIAL CONSTANT	4.20
TERMINAL PSI	2.50
PSI AFTER OVERLAY	4.20
AVERAGE AGE AT TERMINAL PSI FOR EXISTING DESIGN	14.00 YEARS
AVERAGE AGE OF PAVEMENT WHEN 25 PERCENT OF MILEAGE IS ALREADY OVERLAID	11.50 YEARS
AVERAGE AGE OF PAVEMENT WHEN 75 PERCENT OF MILEAGE IS ALREADY OVERLAID	16.00 YEARS
OVERLAY DESIGN LIFE	20.00 YEARS

AGE DISTRIBUTION

LOSS RATE FACTOR FOR MILEAGE IN POTTS - 1.40

AGE	LANE MILES	VALUE	LOSS RATE	AGE	LANE MILES	VALUE	LOSS RATE	AGE	LANE MILES	VALUE	LOSS RATE
1	107.0	287.	3.00	11	48.0	94.	3.00	21	2.0	48.	3.00
2	87.0	270.	3.00	12	28.0	89.	3.00	22	3.0	45.	3.00
3	110.0	264.	3.00	13	17.0	83.	3.00	23	3.0	42.	3.00
4	118.0	251.	3.00	14	22.0	77.	3.00	24	2.0	39.	3.00
5	118.0	182.	3.00	15	17.0	72.	3.00	25	2.0	36.	3.00
6	87.0	159.	3.00	16	10.0	67.	3.00				
7	78.0	146.	3.00	17	17.0	63.	3.00				
8	65.0	134.	3.00	18	13.0	59.	3.00				
9	80.0	114.	3.00	19	10.0	55.	3.00				
10	50.0	102.	3.00	20	7.0	51.	3.00				

VALUE IN THOUSANDS OF DOLLARS
LOSS RATE IN PERCENT PER YEAR

OVERLAY

PERCENT OF PAVED SHOULDERS	95.00	PERCENT
AVERAGE PAVED SHOULDER WIDTH/LANE	7.00	FEET
AVERAGE GRANULAR SHOULDER WIDTH/LANE	5.00	FEET
UNIT COST OF ACP	25.00	$/CY
UNIT COST OF GRANULAR	.35	$/SY/IN.

MODEL MAINTENANCE

ACCELERATED MAINTENANCE - YES

UNIT COSTS OF MAINTENANCE

FLEXIBLE PATCHING ($/SY)	CRACK SEALING ($/FT)	BASE AND SURFACE REPAIR ($/CY)	CONCRETE PATCHING ($/SY)	CONCRETE BLOWUPS ($/AVG)	CONCRETE MUDJACKING ($/AVG)	JOINT SEALING ($/FT)
1.45	.06	9.40	10.30	.00	.00	.20

JOINT SPACING	20.00	FEET
FRACTION OF JOINTS SEALED EACH YEAR	.04	
TIME BEFORE FIRST JOINT SEAL	7	YEARS

MAINTENANCE COSTS PER LANE-MILE PER YEAR

YEAR	FLEXIBLE	RIGID	COMPOSITE
1	.73	.26	.71
2	1.72	.58	1.67
3	4.07	1.29	3.95
4	9.60	2.86	9.33
5	22.55	6.30	21.93
6	52.46	13.72	51.01
7	119.19	29.13	115.90
8	257.58	84.17	250.47
9	505.34	133.91	491.38
10	851.00	200.44	827.50
11	1196.66	266.97	1163.62
12	1444.42	316.72	1404.53
13	1582.81	346.42	1539.10
14	1649.54	361.83	1603.99
15	1679.45	369.25	1633.07
16	1692.40	372.69	1645.67
17	1697.93	374.25	1651.05
18	1700.28	374.96	1653.33
19	1701.27	375.28	1654.29
20	1701.69	375.43	1654.70
21	1701.87	375.49	1654.87
22	1701.95	375.52	1654.95
23	1701.98	375.53	1654.98
24	1701.99	375.54	1654.99

OLD SECTIONS

MAINTENANCE COST (DOLLARS/LANE MILE/YEAR) FOR PAVEMENTS OLDER THAN TERMINAL SERVICEABILITY ---------- 1500.00

PERCENT OF TOTAL LANE MILES IN POTTS AT
BEGINNING OF ANALYSIS PERIOD (CALCULATED) ---------- 11.57
END OF ANALYSIS PERIOD (INPUT TARGET VALUE) ---------- 10.00

PERCENT OF TOTAL LANE MILES NEVER OVERLAID ---------- .00

TRUCK TYPES PRESENT

TYPE	2D	3A	3-S2	2-S1-2	TOTAL
AXLE CODE	1000	0100	0200	4000	
YEAR	PERCENT OF ALL VEHICLES				
1	3.75	.93	12.43	.57	17.68
2	3.81	.93	12.51	.57	17.82

3	3.92	.93	12.60	.57	18.01
4	3.96	.92	12.68	.57	18.13
5	4.04	.92	12.77	.57	18.30
6	4.10	.92	12.75	.57	18.34
7	4.14	.92	12.83	.57	18.46
8	4.21	.91	12.81	.57	18.39
9	4.25	.91	12.89	.57	18.62
10	4.31	.91	12.87	.58	18.67
11	4.35	.91	12.86	.58	18.70
12	4.41	.90	12.85	.58	18.74
13	4.45	.90	12.83	.58	18.76
14	4.48	.90	12.81	.58	18.77
15	4.52	.90	12.79	.58	18.79
16	4.58	.89	12.77	.58	18.82
17	4.63	.89	12.76	.58	18.85
18	4.67	.89	12.74	.58	18.89
19	4.69	.89	12.72	.58	18.89
20	4.73	.88	12.70	.58	18.90

LOAD LIMITS

PRESENT GROSS VEHICLE WEIGHT LIMIT - 80. KIPS
PRESENT SINGLE AXLE WEIGHT LIMIT --- 18. KIPS
PRESENT TANDEM AXLE WEIGHT LIMIT --- 32. KIPS
PRESENT TRIPLE AXLE WEIGHT LIMIT --- 56. KIPS
FUTURE GROSS VEHICLE WEIGHT LIMIT -- 120. KIPS
FUTURE SINGLE AXLE WEIGHT LIMIT ---- 20. KIPS
FUTURE TANDEM AXLE WEIGHT LIMIT ---- 34. KIPS
FUTURE TRIPLE AXLE WEIGHT LIMIT ---- 58. KIPS

TRUCK TYPE	PRESENT STEERING AXLE WEIGHT (KIPS)	FUTURE STEERING AXLE WEIGHT (KIPS)	PERCENT INCREASE IN EMPTY WEIGHT (KIPS)
2D	13.000	16.000	.00
3A	13.000	16.000	.00
3-S2	12.000	16.000	.50
2-S1-2	8.000	16.000	.75

SINGLE AXLE LOADS

NUMBER OF LOAD INTERVALS - 13

LOAD INTERVAL	NUMBER OF AXLES WEIGHED			
	TYPE 2D	TYPE 3A	TYPE 3-S2	TYPE 2-S1-2
.000 - 3.000	12.	0.	0.	0.
3.000 - 7.000	169.	5.	0.	37.

7.000 - 8.000	29.	7.	0.	13.
8.000 - 12.000	50.	19.	0.	89.
12.000 - 16.000	25.	2.	0.	62.
16.000 - 18.000	9.	2.	0.	9.
18.000 - 18.500	0.	0.	0.	2.
18.500 - 20.000	0.	0.	0.	1.
20.000 - 22.000	0.	0.	0.	1.
22.000 - 24.000	0.	0.	0.	1.
24.000 - 26.000	0.	0.	0.	0.
26.000 - 30.000	0.	0.	0.	0.
30.000 - 35.000	0.	0.	0.	0.

TANDEM AXLE LOADS

NUMBER OF LOAD INTERVALS - 16

LOAD INTERVAL	NUMBER OF AXLES WEIGHED			
	TYPE 2D	TYPE 3A	TYPE 3-S2	TYPE 2-S1-2
4.000 - 6.000	0.	0.	68.	0.
6.000 - 12.000	0.	18.	249.	0.
12.000 - 18.000	0.	6.	110.	0.
18.000 - 24.000	0.	3.	160.	0.
24.000 - 30.000	0.	2.	148.	0.
30.000 - 32.000	0.	0.	22.	0.
32.000 - 32.500	0.	2.	6.	0.
32.500 - 34.000	0.	1.	3.	0.
34.000 - 36.000	0.	1.	4.	0.
36.000 - 38.000	0.	2.	1.	0.
38.000 - 40.000	0.	0.	3.	0.
40.000 - 42.000	0.	0.	1.	0.
42.000 - 44.000	0.	0.	0.	0.
44.000 - 46.000	0.	0.	0.	0.
46.000 - 50.000	0.	0.	0.	0.
50.000 - 55.000	0.	0.	0.	0.

GROSS VEHICLE WEIGHT

NUMBER OF LOAD INTERVALS - 23

LOAD INTERVAL	NUMBER OF VEHICLES WEIGHED			
	TYPE 2D	TYPE 3A	TYPE 3-S2	TYPE 2-S1-2
8.000 - 10.000	125.	0.	0.	0.
10.000 - 13.500	110.	1.	0.	0.
13.500 - 20.000	132.	13.	4.	0.
20.000 - 22.000	28.	5.	16.	0.
22.000 - 24.000	15.	1.	46.	0.

24.000 -	26.000	14.	2.	39.	1.
26.000 -	28.000	5.	3.	23.	1.
28.000 -	30.000	7.	0.	16.	0.
30.000 -	32.000	2.	2.	15.	2.
32.000 -	34.000	1.	0.	8.	0.
34.000 -	36.000	2.	2.	12.	1.
36.000 -	38.000	0.	1.	10.	0.
38.000 -	40.000	1.	2.	6.	2.
40.000 -	45.000	0.	1.	12.	1.
45.000 -	50.000	0.	3.	27.	2.
50.000 -	55.000	0.	1.	33.	5.
55.000 -	60.000	0.	0.	58.	10.
60.000 -	65.000	0.	0.	34.	6.
65.000 -	70.000	0.	0.	22.	4.
70.000 -	72.000	0.	0.	0.	0.
72.000 -	75.000	0.	0.	1.	0.
75.000 -	80.000	0.	0.	5.	0.
80.000 -	85.000	0.	0.	1.	0.

EMPTY VEHICLE WEIGHT

NUMBER OF LOAD INTERVALS - 13

LOAD INTERVAL		NUMBER OF VEHICLES WEIGHED			
		TYPE 2D	TYPE 3A	TYPE 3-S2	TYPE 2-S1-2
4.000 -	6.000	14.	0.	0.	0.
6.000 -	8.000	78.	0.	0.	0.
8.000 -	10.000	143.	4.	0.	0.
10.000 -	12.000	107.	10.	0.	0.
12.000 -	14.000	75.	26.	0.	0.
14.000 -	16.000	50.	47.	2.	0.
16.000 -	18.000	9.	35.	4.	0.
18.000 -	20.000	7.	14.	19.	0.
20.000 -	25.000	4.	23.	290.	3.
25.000 -	30.000	0.	6.	262.	10.
30.000 -	35.000	0.	0.	120.	4.
35.000 -	40.000	0.	0.	24.	0.
40.000 -	45.000	0.	0.	4.	2.

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 2D

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
2.000	.00	.00	4.31	.00	.00	.00

4.000	.00	.00	17.48	.00	.00	.00
6.000	.00	.00	41.79	.00	.00	.00
8.000	.00	.00	63.79	.00	.00	.00
10.000	28.28	21.35	76.08	.00	.00	.00
12.000	42.50	37.58	83.37	.00	.00	.00
14.000	55.46	49.47	89.01	.00	.00	.00
16.000	64.65	59.21	92.85	.00	.00	.00
18.000	73.84	67.08	95.89	.00	.00	.00
20.000	83.03	74.83	98.17	.00	.00	.00
22.000	89.37	82.46	100.00	.00	.00	.00
24.000	92.76	87.81	.00	.00	.00	.00
26.000	95.93	91.27	.00	.00	.00	.00
28.000	97.06	93.89	.00	.00	.00	.00
30.000	98.64	96.09	.00	.00	.00	.00
32.000	99.10	96.96	.00	.00	.00	.00
34.000	99.32	98.14	.00	.00	.00	.00
36.000	99.77	98.87	.00	.00	.00	.00
38.000	99.77	99.18	.00	.00	.00	.00
40.000	100.00	99.42	.00	.00	.00	.00
42.000	100.00	99.77	.00	.00	.00	.00
44.000	100.00	99.77	.00	.00	.00	.00
46.000	100.00	99.96	.00	.00	.00	.00
48.000	.00	100.00	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 3A

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
2.000	.00	.00	.00	1.48	.00	.00
4.000	.00	.00	.00	2.97	.00	.00
6.000	.00	.00	.00	4.45	.00	.00
8.000	.00	.00	.00	14.55	.00	.00
10.000	.00	.00	.00	30.43	.00	.00
12.000	1.54	1.28	.00	45.63	.00	.00
14.000	5.41	4.51	.00	54.93	.00	.00
16.000	16.22	12.97	.00	60.11	.00	.00
18.000	27.03	22.95	.00	65.17	.00	.00
20.000	37.84	32.86	.00	69.17	.00	.00
22.000	51.35	43.88	.00	72.00	.00	.00
24.000	54.05	52.29	.00	74.54	.00	.00
26.000	59.46	55.36	.00	76.60	.00	.00
28.000	67.57	60.50	.00	78.56	.00	.00
30.000	67.57	67.57	.00	80.43	.00	.00
32.000	72.97	67.57	.00	82.02	.00	.00
34.000	72.97	71.60	.00	83.61	.00	.00
36.000	78.38	72.97	.00	85.80	.00	.00
38.000	81.08	75.46	.00	91.08	.00	.00
40.000	86.49	79.21	.00	94.52	.00	.00

42.000	87.57	81.88	.00	97.73	.00	.00
44.000	88.65	86.40	.00	100.00	.00	.00
46.000	90.81	87.36	.00	.00	.00	.00
48.000	94.05	88.25	.00	.00	.00	.00
50.000	97.30	89.73	.00	.00	.00	.00
52.000	98.38	92.11	.00	.00	.00	.00
54.000	99.46	95.03	.00	.00	.00	.00
56.000	100.00	97.51	.00	.00	.00	.00
58.000	.00	98.49	.00	.00	.00	.00
60.000	.00	99.46	.00	.00	.00	.00
62.000	.00	99.95	.00	.00	.00	.00
64.000	.00	100.00	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 3-S2

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
2.000	.00	.00	.00	1.92	.00	.00
4.000	.00	.00	.00	3.83	.00	.00
6.000	.00	.00	.00	8.33	.00	.00
8.000	.00	.00	.00	18.02	.00	.00
10.000	.00	.00	.00	28.20	.00	.00
12.000	.00	.00	.00	38.12	.00	.00
14.000	.08	.07	.00	43.98	.00	.00
16.000	.40	.34	.00	48.45	.00	.00
18.000	.71	.65	.00	52.74	.00	.00
20.000	1.03	.95	.00	57.80	.00	.00
22.000	5.15	3.85	.00	63.79	.00	.00
24.000	17.01	12.56	.00	69.88	.00	.00
26.000	27.06	22.66	.00	75.98	.00	.00
28.000	32.99	30.00	.00	81.67	.00	.00
30.000	37.11	34.73	.00	87.23	.00	.00
32.000	40.98	38.45	.00	92.60	.00	.00
34.000	43.04	41.53	.00	95.39	.00	.00
36.000	46.13	43.60	.00	96.10	.00	.00
38.000	48.71	46.37	.00	96.82	.00	.00
40.000	50.26	48.71	.00	97.54	.00	.00
42.000	51.49	50.11	.00	98.25	.00	.00
44.000	52.73	51.25	.00	98.97	.00	.00
46.000	54.74	52.36	.00	99.68	.00	.00
48.000	57.53	53.91	.00	100.00	.00	.00
50.000	60.31	56.06	.00	.00	.00	.00
52.000	63.71	58.52	.00	.00	.00	.00
54.000	67.11	61.11	.00	.00	.00	.00
56.000	71.80	64.09	.00	.00	.00	.00
58.000	77.78	67.06	.00	.00	.00	.00
60.000	83.76	71.11	.00	.00	.00	.00
62.000	87.27	76.08	.00	.00	.00	.00

64.000	90.77	81.23	.00	.00	.00	.00
66.000	93.66	85.28	.00	.00	.00	.00
68.000	95.93	88.28	.00	.00	.00	.00
70.000	98.20	91.17	.00	.00	.00	.00
72.000	98.20	93.62	.00	.00	.00	.00
74.000	98.37	95.54	.00	.00	.00	.00
76.000	98.71	97.45	.00	.00	.00	.00
78.000	99.23	98.20	.00	.00	.00	.00
80.000	99.74	98.25	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 3-S2

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
82.000	99.85	98.43	.00	.00	.00	.00
84.000	99.95	98.71	.00	.00	.00	.00
86.000	100.00	99.18	.00	.00	.00	.00
88.000	.00	99.64	.00	.00	.00	.00
90.000	.00	99.82	.00	.00	.00	.00
92.000	.00	99.91	.00	.00	.00	.00
94.000	.00	99.98	.00	.00	.00	.00
96.000	.00	100.00	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 2-S1-2

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
2.000	.00	.00	2.23	.00	.00	.00
4.000	.00	.00	4.45	.00	.00	.00
6.000	.00	.00	10.53	.00	.00	.00
8.000	.00	.00	18.60	.00	.00	.00
10.000	.00	.00	30.96	.00	.00	.00
12.000	.00	.00	47.67	.00	.00	.00
14.000	.00	.00	64.38	.00	.00	.00
16.000	.00	.00	76.24	.00	.00	.00
18.000	.00	.00	87.58	.00	.00	.00
20.000	.00	.00	95.02	.00	.00	.00
22.000	.00	.00	96.07	.00	.00	.00
24.000	.00	.00	97.12	.00	.00	.00
26.000	2.86	.44	98.17	.00	.00	.00

28.000	5.71	2.94	99.22	.00	.00	.00
30.000	5.71	5.42	100.00	.00	.00	.00
32.000	11.43	5.71	.00	.00	.00	.00
34.000	11.43	9.18	.00	.00	.00	.00
36.000	14.29	11.43	.00	.00	.00	.00
38.000	14.29	12.26	.00	.00	.00	.00
40.000	20.00	14.29	.00	.00	.00	.00
42.000	21.14	14.29	.00	.00	.00	.00
44.000	22.29	18.66	.00	.00	.00	.00
46.000	24.00	20.66	.00	.00	.00	.00
48.000	26.29	21.58	.00	.00	.00	.00
50.000	28.57	22.61	.00	.00	.00	.00
52.000	34.29	23.97	.00	.00	.00	.00
54.000	40.00	25.76	.00	.00	.00	.00
56.000	48.57	27.55	.00	.00	.00	.00
58.000	60.00	30.47	.00	.00	.00	.00
60.000	71.43	34.89	.00	.00	.00	.00
62.000	78.29	39.27	.00	.00	.00	.00
64.000	85.14	45.44	.00	.00	.00	.00
66.000	90.86	53.05	.00	.00	.00	.00
68.000	95.43	61.66	.00	.00	.00	.00
70.000	100.00	70.21	.00	.00	.00	.00
72.000	.00	75.79	.00	.00	.00	.00
74.000	.00	80.85	.00	.00	.00	.00
76.000	.00	85.76	.00	.00	.00	.00
78.000	.00	89.93	.00	.00	.00	.00
80.000	.00	93.43	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 2-S1-2

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
82.000	.00	96.72	.00	.00	.00	.00
84.000	.00	100.00	.00	.00	.00	.00
86.000	.00	100.00	.00	.00	.00	.00

TRUCK TYPE	PAYLOAD PER TRUCK		18-KIP AXLES PER TRUCK	
	PRESENT	PROPOSED	PRESENT	PROPOSED
2D	3.97	5.30	.08	.14
3A	9.71	11.69	.26	.38
3-S2	15.53	18.21	.36	.57
2-S1-2	23.42	31.56	.89	1.98

YEAR	18-KIP ESAL RATIO (PROPOSED/PRESENT)	YEAR	18-KIP ESAL RATIO (PROPOSED/PRESENT)
1	1.391	11	1.390
2	1.391	12	1.390
3	1.390	13	1.390
4	1.390	14	1.390
5	1.390	15	1.390
6	1.390	16	1.390
7	1.390	17	1.390
8	1.390	18	1.390
9	1.390	19	1.390
10	1.390	20	1.390

AVERAGE PAVEMENT AGE WHEN 25 PERCENT OF MILEAGE IS ALREADY OVERLAID -	11.50 YEARS
AVERAGE PAVEMENT AGE WHEN 75 PERCENT OF MILEAGE IS ALREADY OVERLAID -	16.00 YEARS
AVERAGE AGE AT TERMINAL PSI FOR EXISTING DESIGN ----------	14.00 YEARS
STANDARD DEVIATION OF THE SURVIVOR CURVE ----------	3.34 YEARS
PERCENT OF TOTAL LANE MILES IN POTTS (BEGINNING OF ANALYSIS PERIOD) ----------	11.57

LANE-MILES FROM GIVEN AGE SLICE DUE FOR TIMELY OVERLAY IN GIVEN ANALYSIS YEAR

VALUE	LOSS RATE	PAVEMENT AGE AT BEGINNING OF A.P.	TOTAL	INTO POTTS	ANALYSIS YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13
287.	3.00	1	107.0	.0	.0	.0	.0	.0	.0	.0	2.7	4.4	6.6	9.0	11.3	12.9	13.5
270.	3.00	2	87.0	.0	.0	.0	.0	.0	.0	2.2	3.6	5.3	7.3	9.2	10.5	11.0	10.5
264.	3.00	3	110.0	.0	.0	.0	.0	.0	2.8	4.5	6.8	9.2	11.6	13.2	13.8	13.2	11.6
251.	3.00	4	118.0	.0	.0	.0	.0	3.0	4.8	7.2	9.9	12.4	14.2	14.9	14.2	12.4	9.9
182.	3.00	5	118.0	.0	.0	.0	3.0	4.8	7.2	9.9	12.4	14.2	14.9	14.2	12.4	9.9	7.2
159.	3.00	6	87.0	.0	.0	2.2	3.6	5.3	7.3	9.2	10.5	11.0	10.5	9.2	7.3	5.3	3.6
146.	3.00	7	78.0	.0	2.0	3.2	4.8	6.6	8.2	9.4	9.8	9.4	8.2	6.6	4.8	3.2	2.0
134.	3.00	8	65.0	1.6	2.7	4.0	5.5	6.8	7.8	8.2	7.8	6.8	5.5	4.0	2.7	1.6	.0
114.	3.00	9	80.0	5.3	4.9	6.7	8.4	9.6	10.1	9.6	8.4	6.7	4.9	3.3	2.0	.0	.0
102.	3.00	10	50.0	6.4	4.2	5.3	6.0	6.3	6.0	5.3	4.2	3.1	2.1	1.3	.0	.0	.0
94.	3.00	11	48.0	10.2	5.0	5.8	6.0	5.8	5.0	4.0	2.9	2.0	1.2	.0	.0	.0	.0
89.	3.00	12	28.0	8.9	3.4	3.5	3.4	2.9	2.4	1.7	1.1	.7	.0	.0	.0	.0	.0
83.	3.00	13	17.0	7.4	2.1	2.0	1.8	1.4	1.0	.7	.4	.0	.0	.0	.0	.0	.0
77.	3.00	14	22.0	12.4	2.6	2.3	1.8	1.4	.9	.6	.0	.0	.0	.0	.0	.0	.0
72.	3.00	15	17.0	11.6	1.8	1.4	1.0	.7	.4	.0	.0	.0	.0	.0	.0	.0	.0
67.	3.00	16	10.0	7.9	.8	.6	.4	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0
63.	3.00	17	17.0	14.8	1.0	.7	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
59.	3.00	18	13.0	12.1	.5	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
55.	3.00	19	10.0	9.7	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
51.	3.00	20	7.0	7.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
48.	3.00	21	2.0	2.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
45.	3.00	22	3.0	3.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
42.	3.00	23	3.0	3.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
39.	3.00	24	2.0	2.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
36.	3.00	25	2.0	2.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

TOTALS	127.3	31.4	38.1	46.1	54.9	64.0	72.5	80.6	85.2	86.8	84.7	79.0	69.6	58.2
AVERAGE AGE AT TERMINAL PSI		12.29	12.36	12.42	12.54	12.73	12.95	13.15	13.52	13.94	14.40	14.92	15.47	16.09

VALUE IN THOUSANDS OF DOLLARS LOSS RATE IN PERCENT PER YEAR

LANE-MILES FROM GIVEN AGE SLICE DUE FOR TIMELY OVERLAY IN GIVEN ANALYSIS YEAR

PAVEMENT AGE AT BEGINNING OF A.P.	ANALYSIS YEAR 14	15	16	17	18	19
1	12.9	11.3	9.0	6.6	4.4	2.7
2	9.2	7.3	5.3	3.6	2.2	.0
3	9.2	6.8	4.5	2.8	.0	.0
4	7.2	4.8	3.0	.0	.0	.0
5	4.8	3.0	.0	.0	.0	.0
6	2.2	.0	.0	.0	.0	.0
7	.0	.0	.0	.0	.0	.0
8	.0	.0	.0	.0	.0	.0
9	.0	.0	.0	.0	.0	.0
10	.0	.0	.0	.0	.0	.0
11	.0	.0	.0	.0	.0	.0
12	.0	.0	.0	.0	.0	.0
13	.0	.0	.0	.0	.0	.0
14	.0	.0	.0	.0	.0	.0
15	.0	.0	.0	.0	.0	.0
16	.0	.0	.0	.0	.0	.0
17	.0	.0	.0	.0	.0	.0
18	.0	.0	.0	.0	.0	.0
19	.0	.0	.0	.0	.0	.0
20	.0	.0	.0	.0	.0	.0
21	.0	.0	.0	.0	.0	.0
22	.0	.0	.0	.0	.0	.0
23	.0	.0	.0	.0	.0	.0
24	.0	.0	.0	.0	.0	.0
25	.0	.0	.0	.0	.0	.0
TOTALS	45.5	33.1	21.8	12.9	6.6	2.7
AVERAGE AGE AT TERMINAL PSI	16.75	17.42	18.07	18.70	19.33	20.00

VALUE IN THOUSANDS OF DOLLARS LOSS RATE IN PERCENT PER YEAR

PERFORMANCE TABLE
PRESENT REGULATIONS

LANE MILES DUE OVERLAY	LANE MILES OVERLAID	YEAR OF OVERLAY	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT BEGINNING OF ANALYSIS	PSI AT END PERIOD	REMAINING LIFE (MILLION 18-KIP EAL)	OVERLAY COST ($/LANE MILE)
31.4	27.8	1.00	5.24	3.57	2.58	2.55	1.698	27280.
38.1	33.8	2.00	5.23	3.56	2.67	2.60	3.348	27221.
46.1	40.9	3.00	5.23	3.55	2.76	2.65	4.948	27158.
54.9	48.7	4.00	5.22	3.54	2.85	2.70	6.479	27050.
64.0	56.8	5.00	5.21	3.51	2.93	2.76	7.918	26888.
72.5	64.3	6.00	5.20	3.49	3.02	2.81	9.268	26696.
80.6	71.5	7.00	5.19	3.47	3.11	2.87	10.566	26526.
85.2	75.6	8.00	5.17	3.43	3.19	2.93	11.668	26214.
86.8	77.0	9.00	5.15	3.38	3.27	2.99	12.663	25881.
84.7	75.1	10.00	5.13	3.33	3.35	3.05	13.553	25448.
79.0	70.0	11.00	5.11	3.28	3.42	3.11	14.320	25065.
69.6	61.7	12.00	5.09	3.23	3.49	3.18	15.002	24679.
58.2	51.6	13.00	5.06	3.17	3.55	3.25	15.562	24258.
45.5	40.4	14.00	5.04	3.12	3.60	3.33	16.051	23841.
33.1	29.4	15.00	5.01	3.06	3.66	3.41	16.480	23431.
21.8	19.3	16.00	4.99	3.01	3.71	3.50	16.896	23059.
12.9	11.4	17.00	4.97	2.97	3.77	3.60	17.280	22705.
6.6	5.8	18.00	4.95	2.92	3.83	3.71	17.641	22372.
2.7	2.4	19.00	4.93	2.88	3.89	3.86	17.942	22033.

PERFORMANCE TABLE
PROPOSED REGULATIONS

LANE MILES DUE OVERLAY	LANE MILES OVERLAID	YEAR OF OVERLAY	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT BEGINNING OF ANALYSIS	PSI AT END PERIOD	REMAINING LIFE (MILLION 18-KIP EAL)	OVERLAY COST ($/LANE MILE)
31.4	27.8	.72	5.48	4.11	2.58	2.53	1.698	31456.
38.1	33.8	1.45	5.47	4.09	2.67	2.57	3.346	31324.
46.1	40.9	2.18	5.46	4.08	2.76	2.61	4.946	31189.
54.9	48.7	2.91	5.45	4.05	2.85	2.64	6.476	31010.
64.0	56.8	3.64	5.44	4.02	2.93	2.68	7.915	30775.
72.5	64.3	4.39	5.42	3.99	3.02	2.72	9.265	30512.
80.6	71.5	5.13	5.41	3.96	3.11	2.76	10.563	30273.
85.2	75.6	5.88	5.39	3.91	3.19	2.80	11.666	29889.
86.8	77.0	6.63	5.36	3.85	3.27	2.84	12.661	29485.
84.7	75.1	7.39	5.34	3.80	3.35	2.88	13.551	29064.
79.0	70.0	8.15	5.31	3.74	3.42	2.93	14.319	28608.
69.6	61.7	8.91	5.29	3.68	3.49	2.97	15.001	28151.
58.2	51.6	9.68	5.26	3.62	3.55	3.02	15.561	27659.
45.5	40.4	10.45	5.23	3.55	3.60	3.07	16.050	27172.
33.1	29.4	11.22	5.20	3.49	3.66	3.12	16.479	26693.
21.8	19.3	12.00	5.18	3.43	3.71	3.17	16.895	26254.
12.9	11.4	12.78	5.15	3.37	3.77	3.23	17.279	25752.
6.6	5.8	13.56	5.12	3.32	3.83	3.29	17.640	25358.
2.7	2.4	14.35	5.10	3.26	3.89	3.35	17.942	24959.

POTTS TABLE
PRESENT REGULATIONS

ANALYSIS YEAR	LANE MILES IN POTTS	LANE MILES OVERLAID FROM POTTS	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT END OF ANALYSIS PERIOD	OVERLAY COST ($/LANE-MILE)
1	126.8	4.1	4.81	4.72	2.55	36077.
2	126.1	5.0	4.82	4.75	2.60	36315.
3	125.3	6.0	4.84	4.78	2.66	36553.
4	124.3	7.2	4.85	4.81	2.71	36793.
5	123.2	8.4	4.86	4.84	2.77	37032.
6	121.9	9.5	4.88	4.87	2.83	37272.
7	120.5	10.5	4.89	4.90	2.88	37512.
8	119.0	11.1	4.91	4.94	2.94	37753.
9	117.4	11.4	4.92	4.97	3.00	37994.
10	115.9	11.1	4.93	5.00	3.06	38236.
11	114.5	10.3	4.95	5.03	3.12	38478.
12	113.3	9.1	4.96	5.06	3.19	38720.
13	112.3	7.6	4.98	5.09	3.26	38963.
14	111.5	6.0	4.99	5.13	3.33	39206.
15	110.9	4.3	5.00	5.16	3.41	39450.
16	110.5	2.9	5.02	5.19	3.50	39694.
17	110.3	1.7	5.03	5.22	3.59	39938.
18	110.1	.9	5.05	5.25	3.70	40183.
19	110.1	.4	5.06	5.29	3.85	40428.
20	110.1	.0	5.07	5.32	4.20	40674.

POTTS TABLE
PROPOSED REGULATIONS

ANALYSIS YEAR	LANE MILES IN POTTS	LANE MILES OVERLAID FROM POTTS	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT END OF ANALYSIS PERIOD	OVERLAY COST ($/LANE-MILE)
1	126.8	4.1	5.04	5.24	2.55	40092.
2	126.1	5.0	5.05	5.27	2.60	40337.
3	124.3	13.2	5.07	5.31	2.65	40583.
4	123.2	8.4	5.08	5.34	2.70	40829.
5	121.9	9.5	5.10	5.37	2.76	41075.
6	119.0	21.7	5.11	5.40	2.81	41322.
7	117.4	11.4	5.13	5.43	2.87	41570.
8	115.9	11.1	5.14	5.47	2.92	41817.
9	113.3	19.4	5.16	5.51	2.99	42150.
10	112.3	7.6	5.17	5.54	3.05	42400.
11	111.5	6.0	5.19	5.58	3.11	42651.
12	110.5	7.2	5.20	5.61	3.17	42902.
13	110.3	1.7	5.22	5.64	3.24	43153.
14	110.1	.9	5.23	5.67	3.31	43405.
15	110.1	.4	5.25	5.71	3.39	43657.
16	110.1	.0	5.26	5.74	3.47	43910.

17	110.1	.0	5.27	5.77	3.57	44163.
18	110.1	.0	5.29	5.81	3.68	44416.
19	110.1	.0	5.30	5.84	3.83	44670.
20	110.1	.0	5.32	5.87	4.20	44924.

U N D I S C O U N T E D C O S T S
(MILLIONS OF DOLLARS)

YEAR IN ANALYSIS PERIOD	MAINTENANCE		OVERLAY	
	PRESENT	PROPOSED	PRESENT	PROPOSED
1	.447	.544	.908	1.041
2	.515	.702	1.100	1.259
3	.599	.881	1.332	3.323
4	.699	1.050	1.581	2.090
5	.805	1.218	1.837	2.350
6	.902	1.243	2.069	5.319
7	.968	1.134	2.291	2.742
8	.983	.968	2.403	2.646
9	.944	.762	2.424	4.559
10	.870	.591	2.335	1.750
11	.786	.504	2.153	1.351
12	.714	.483	1.875	1.600
13	.669	.525	1.549	.367
14	.656	.633	1.196	.185
15	.679	.779	.859	.075
16	.736	.945	.559	.000
17	.824	1.117	.327	.000
18	.936	1.283	.165	.000
19	1.062	1.434	.067	.000
20	1.194	1.562	.000	.000
TOTALS	15.988	18.363	27.030	30.658

S A L V A G E V A L U E
(MILLIONS OF DOLLARS)

	ANALYSIS PERIOD	
	BEGINNING	END
PRESENT	-197.739	-118.024
PROPOSED	-197.739	-116.287
DELTA		1.737

INPUT
(RIGID PAVEMENT)

```
RUN PARAMETERS          20    0      2.00        6.00         .00          .00          .00
SYSTEM TITLE             0    0       .00         .00         .00          .00          .00

SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

RIGID                    0    0     12.00      250.00       690.00 4200000.00          .00
INTRIG A  INTERSTATE RIGID PAVEMENT SECTION *A*

JCP    8.0 .000 CTB    7.0 .000          .0 .000          .0 .000

AGE DISTRIBUTION        25    1      1.40         .00          .00          .00          .00
   217.0   175.0   223.0   242.0   240.0   175.0   158.0   132.0   162.0   102.0    99.0    53.0    33.0    43.0    33.0
    20.0    33.0    26.0    20.0    14.0     4.0     6.0     4.0     2.0     4.0
    526.00   499.00   493.00   474.00   347.00   306.00   283.00   262.00
    226.00   203.00   191.00   180.00   170.00   160.00   151.00   142.00
    134.00   126.00   119.00   112.00   106.00   100.00    94.00    89.00
     84.00
      2.00     2.00     2.00     2.00     2.00     2.00     2.00     2.00
      2.00     2.00     2.00     2.00     2.00     2.00     2.00     2.00
      2.00     2.00     2.00     2.00     2.00     2.00     2.00     2.00
      2.00
PERFORMANCE              0    0      4.20        2.50         4.20        20.00          .00
     23.00    19.00    28.00
MODEL MAINT              1    0       .00         .00          .00          .00          .00
      1.45      .06     9.40
     10.30      .00      .00      .20    20.00      .04    7
OVERLAY                  2    3       .00         .00          .00          .00          .00
     95.00     7.00     5.00    25.00      .35      .00      .00
OLD SECTIONS             1    0    350.00       10.00          .00          .00          .00
OUTPUT                   3    0       .00         .00          .00          .00          .00
TRUCK TYPE               4    0       .00         .00          .00          .00          .00
2D       3A          3-S2        2-S1-2
 1 0 0 0   0 1 0 0   0 2 0 0   4 0 0 0
  1   3.75   .93 12.43   .57   .00   .00   .00   .00   .00   .00 17.68
  2   3.81   .93 12.51   .57   .00   .00   .00   .00   .00   .00 17.82
  3   3.92   .93 12.60   .57   .00   .00   .00   .00   .00   .00 18.01
  4   3.96   .92 12.68   .57   .00   .00   .00   .00   .00   .00 18.13
  5   4.04   .92 12.77   .57   .00   .00   .00   .00   .00   .00 18.30
  6   4.10   .92 12.75   .57   .00   .00   .00   .00   .00   .00 18.34
  7   4.14   .92 12.83   .57   .00   .00   .00   .00   .00   .00 18.46
  8   4.21   .91 12.81   .57   .00   .00   .00   .00   .00   .00 18.39
  9   4.25   .91 12.89   .57   .00   .00   .00   .00   .00   .00 18.62
 10   4.31   .91 12.87   .58   .00   .00   .00   .00   .00   .00 18.67
 11   4.35   .91 12.86   .58   .00   .00   .00   .00   .00   .00 18.70
 12   4.41   .90 12.85   .58   .00   .00   .00   .00   .00   .00 18.74
 13   4.45   .90 12.83   .58   .00   .00   .00   .00   .00   .00 18.76
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14	4.48	.90	12.81	.58	.00	.00	.00	.00	.00	.00	18.77		
15	4.52	.90	12.79	.58	.00	.00	.00	.00	.00	.00	18.79		
16	4.58	.89	12.77	.58	.00	.00	.00	.00	.00	.00	18.82		
17	4.63	.89	12.76	.58	.00	.00	.00	.00	.00	.00	18.85		
18	4.67	.89	12.74	.58	.00	.00	.00	.00	.00	.00	18.89		
19	4.69	.89	12.72	.58	.00	.00	.00	.00	.00	.00	18.89		
20	4.73	.88	12.70	.58	.00	.00	.00	.00	.00	.00	18.90		
LOAD LIMITS				1	0	.00		.00		.00		.00	.00
	80.00		18.00		32.00	56.00							
	120.00		20.00		34.00	58.00							
	13.	13.		12.	8.								
	16.	16.		16.	16.								
	.00	.00		.50	.75								
SINGLE AXLES				13	0	.00		.00		.00		.00	.00
	3.	12.		0.	0.	0.							
	7.	169.		5.	0.	37.							
	8.	29.		7.	0.	13.							
	12.	50.		19.	0.	89.							
	16.	25.		2.	0.	62.							
	18.	9.		2.	0.	9.							
	19.	0.		0.	0.	2.							
	20.	0.		0.	0.	1.							
	22.	0.		0.	0.	1.							
	24.	0.		0.	0.	1.							
	26.	0.		0.	0.	0.							
	30.	0.		0.	0.	0.							
	35.	0.		0.	0.	0.							
TANDEM AXLES				16	0	4.00		.00		.00		.00	.00
	6.	0.		0.	68.	0.							
	12.	0.		18.	249.	0.							
	18.	0.		6.	110.	0.							
	24.	0.		3.	160.	0.							
	30.	0.		2.	148.	0.							
	32.	0.		0.	22.	0.							
	33.	0.		2.	6.	0.							
	34.	0.		1.	3.	0.							
	36.	0.		1.	4.	0.							
	38.	0.		2.	1.	0.							
	40.	0.		0.	3.	0.							
	42.	0.		0.	1.	0.							
	44.	0.		0.	0.	0.							
	46.	0.		0.	0.	0.							
	50.	0.		0.	0.	0.							
	55.	0.		0.	0.	0.							
GVW				23	0	8.00		.00		.00		.00	.00
	10.	125.		0.	0.	0.							
	14.	110.		1.	0.	0.							
	20.	132.		13.	4.	0.							
	22.	28.		5.	16.	0.							
	24.	15.		1.	46.	0.							
	26.	14.		2.	39.	1.							
	28.	5.		3.	23.	1.							
	30.	7.		0.	16.	0.							
	32.	2.		2.	15.	2.							
	34.	1.		0.	8.	0.							
	36.	2.		2.	12.	1.							

	38.	0.	1.	10.	0.				
	40.	1.	2.	6.	2.				
9	45.	0.	1.	12.	1.				
	50.	0.	3.	27.	2.				
	55.	0.	1.	33.	5.				
	60.	0.	0.	58.	10.				
	65.	0.	0.	34.	6.				
	70.	0.	0.	22.	4.				
	72.	0.	0.	0.	0.				
	75.	0.	0.	1.	0.				
	80.	0.	0.	5.	0.				
	85.	0.	0.	1.	0.				
EMPTY			13	0	4.00	.00	.00	.00	.00
	6.	14.	0.	0.	0.				
	8.	78.	0.	0.	0.				
	10.	143.	4.	0.	0.				
	12.	107.	10.	0.	0.				
	14.	75.	26.	0.	0.				
	16.	50.	47.	2.	0.				
	18.	9.	35.	4.	0.				
	20.	7.	14.	19.	0.				
	25.	4.	23.	290.	3.				
	30.	0.	6.	262.	10.				
	35.	0.	0.	120.	4.				
	40.	0.	0.	24.	0.				
	45.	0.	0.	4.	2.				
EXECUTE			0	0	.00	.00	.00	.00	.00

OUTPUT
(RIGID PAVEMENT)

SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

INTRIG A INTERSTATE RIGID PAVEMENT SECTION *A*

RUN PARAMETERS

LENGTH OF ANALYSIS PERIOD	20 YEARS
ANNUAL GROWTH RATE OF 18 KIP EAL	2.00 PERCENT/YEAR
ANNUAL INTEREST RATE FOR PRESENT WORTH CALCULATIONS	6.00 PERCENT/YEAR

NUMBER OF 18-KIP ESAL UNDER PROPOSED REGULATIONS
DERIVED FROM 18-KIP ESAL UNDER PRESENT REGULATIONS
AND THE ASSUMPTION OF EQUAL PAYLOAD

RIGID STRUCTURE

NUMBER OF LAYERS	2
LANE WIDTH	12.0 FEET
SUBBASE MODULUS	250. PCI
FLEX STRENGTH	690. PSI
CONCRETE MODULUS	4200000. PCI

MATERIALS

LAYER NUMBER	THICKNESS (IN.)	MATERIAL CODE	
1	8.00	JCP	JCP SURFACE
2	7.00	CTB	CEMENT TREATED BASE

PERFORMANCE

PSI INITIAL CONSTANT	4.20
TERMINAL PSI	2.50
PSI AFTER OVERLAY	4.20
AVERAGE AGE AT TERMINAL PSI FOR EXISTING DESIGN	23.00 YEARS
AVERAGE AGE OF PAVEMENT WHEN 25 PERCENT OF MILEAGE IS ALREADY OVERLAID	19.00 YEARS

AVERAGE AGE OF PAVEMENT WHEN 75 PERCENT OF MILEAGE IS ALREADY OVERLAID - 28.00 YEARS
OVERLAY DESIGN LIFE ---------- 20.00 YEARS

AGE DISTRIBUTION

LOSS RATE FACTOR FOR MILEAGE IN POTTS - 1.40

AGE	LANE MILES	VALUE	LOSS RATE	AGE	LANE MILES	VALUE	LOSS RATE	AGE	LANE MILES	VALUE	LOSS RATE
1	217.0	526.	2.00	11	99.0	191.	2.00	21	4.0	106.	2.00
2	175.0	499.	2.00	12	53.0	180.	2.00	22	6.0	100.	2.00
3	223.0	493.	2.00	13	33.0	170.	2.00	23	4.0	94.	2.00
4	242.0	474.	2.00	14	43.0	160.	2.00	24	2.0	89.	2.00
5	240.0	347.	2.00	15	33.0	151.	2.00	25	4.0	84.	2.00
6	175.0	306.	2.00	16	20.0	142.	2.00				
7	158.0	283.	2.00	17	33.0	134.	2.00				
8	132.0	262.	2.00	18	26.0	126.	2.00				
9	162.0	226.	2.00	19	20.0	119.	2.00				
10	102.0	203.	2.00	20	14.0	112.	2.00				

VALUE IN THOUSANDS OF DOLLARS
LOSS RATE IN PERCENT PER YEAR

OVERLAY

PERCENT OF PAVED SHOULDERS ---------- 95.00 PERCENT
AVERAGE PAVED SHOULDER WIDTH/LANE ---- 7.00 FEET
AVERAGE GRANULAR SHOULDER WIDTH/LANE - 5.00 FEET
UNIT COST OF ACP ---------- 25.00 $/CY
UNIT COST OF GRANULAR ---------- .35 $/SY/IN.

MODEL MAINTENANCE

ACCELERATED MAINTENANCE - YES

UNIT COSTS OF MAINTENANCE

FLEXIBLE PATCHING ($/SY)	CRACK SEALING ($/FT)	BASE AND SURFACE REPAIR ($/CY)	CONCRETE PATCHING ($/SY)	CONCRETE BLOWUPS ($/AVG)	CONCRETE MUDJACKING ($/AVG)	JOINT SEALING ($/FT)
1.45	.06	9.40	10.30	.00	.00	.20

JOINT SPACING ---------- 20.00 FEET
FRACTION OF JOINTS SEALED EACH YEAR - .04
TIME BEFORE FIRST JOINT SEAL ---------- 7 YEARS

MAINTENANCE COSTS PER LANE-MILE PER YEAR

YEAR	FLEXIBLE	RIGID	COMPOSITE
1	.73	.26	.71
2	1.72	.58	1.67
3	4.07	1.29	3.95
4	9.60	2.86	9.33
5	22.55	6.30	21.93
6	52.46	13.72	51.01
7	119.19	29.13	115.90
8	257.58	84.17	250.47
9	505.34	133.91	491.38
10	851.00	200.44	827.50
11	1196.66	266.97	1163.62
12	1444.42	316.72	1404.53
13	1582.81	346.42	1539.10
14	1649.54	361.83	1603.99
15	1679.45	369.25	1633.07
16	1692.40	372.69	1645.67
17	1697.93	374.25	1651.05
18	1700.28	374.96	1653.33
19	1701.27	375.28	1654.29
20	1701.69	375.43	1654.70
21	1701.87	375.49	1654.87
22	1701.95	375.52	1654.95
23	1701.98	375.53	1654.98
24	1701.99	375.54	1654.99

OLD SECTIONS

MAINTENANCE COST (DOLLARS/LANE MILE/YEAR) FOR PAVEMENTS OLDER THAN TERMINAL SERVICEABILITY ---------- 350.00

PERCENT OF TOTAL LANE MILES IN POTTS AT
BEGINNING OF ANALYSIS PERIOD (CALCULATED) ---------- 1.07
END OF ANALYSIS PERIOD (INPUT TARGET VALUE) ---------- 10.00

PERCENT OF TOTAL LANE MILES NEVER OVERLAID ---------- .00

TRUCK TYPES PRESENT

TYPE	2D	3A	3-S2	2-S1-2	TOTAL
AXLE CODE	1000	0100	0200	4000	
YEAR	PERCENT OF ALL VEHICLES				
1	3.75	.93	12.43	.57	17.68
2	3.81	.93	12.51	.57	17.82

3	3.92	.93	12.60	.57	18.01
4	3.96	.92	12.68	.57	18.13
5	4.04	.92	12.77	.57	18.30
6	4.10	.92	12.75	.57	18.34
7	4.14	.92	12.83	.57	18.46
8	4.21	.91	12.81	.57	18.39
9	4.25	.91	12.89	.57	18.62
10	4.31	.91	12.87	.58	18.67
11	4.35	.91	12.86	.58	18.70
12	4.41	.90	12.85	.58	18.74
13	4.45	.90	12.83	.58	18.76
14	4.48	.90	12.81	.58	18.77
15	4.52	.90	12.79	.58	18.79
16	4.58	.89	12.77	.58	18.82
17	4.63	.89	12.76	.58	18.85
18	4.67	.89	12.74	.58	18.89
19	4.69	.89	12.72	.58	18.89
20	4.73	.88	12.70	.58	18.90

LOAD LIMITS

PRESENT GROSS VEHICLE WEIGHT LIMIT - 80. KIPS
PRESENT SINGLE AXLE WEIGHT LIMIT --- 18. KIPS
PRESENT TANDEM AXLE WEIGHT LIMIT --- 32. KIPS
PRESENT TRIPLE AXLE WEIGHT LIMIT --- 56. KIPS
FUTURE GROSS VEHICLE WEIGHT LIMIT -- 120. KIPS
FUTURE SINGLE AXLE WEIGHT LIMIT ---- 20. KIPS
FUTURE TANDEM AXLE WEIGHT LIMIT ---- 34. KIPS
FUTURE TRIPLE AXLE WEIGHT LIMIT ---- 58. KIPS

TRUCK TYPE	PRESENT STEERING AXLE WEIGHT (KIPS)	FUTURE STEERING AXLE WEIGHT (KIPS)	PERCENT INCREASE IN EMPTY WEIGHT (KIPS)
2D	13.000	16.000	.00
3A	13.000	16.000	.00
3-S2	12.000	16.000	.50
2-S1-2	8.000	16.000	.75

SINGLE AXLE LOADS

NUMBER OF LOAD INTERVALS - 13

LOAD INTERVAL	NUMBER OF AXLES WEIGHED			
	TYPE 2D	TYPE 3A	TYPE 3-S2	TYPE 2-S1-2
.000 - 3.000	12.	0.	0.	0.
3.000 - 7.000	169.	5.	0.	37.

7.000 - 8.000	29.	7.	0.	13.
8.000 - 12.000	50.	19.	0.	89.
12.000 - 16.000	25.	2.	0.	62.
16.000 - 18.000	9.	2.	0.	9.
18.000 - 18.500	0.	0.	0.	2.
18.500 - 20.000	0.	0.	0.	1.
20.000 - 22.000	0.	0.	0.	1.
22.000 - 24.000	0.	0.	0.	1.
24.000 - 26.000	0.	0.	0.	0.
26.000 - 30.000	0.	0.	0.	0.
30.000 - 35.000	0.	0.	0.	0.

TANDEM AXLE LOADS

NUMBER OF LOAD INTERVALS - 16

LOAD INTERVAL	NUMBER OF AXLES WEIGHED			
	TYPE 2D	TYPE 3A	TYPE 3-S2	TYPE 2-S1-2
4.000 - 6.000	0.	0.	68.	0.
6.000 - 12.000	0.	18.	249.	0.
12.000 - 18.000	0.	6.	110.	0.
18.000 - 24.000	0.	3.	160.	0.
24.000 - 30.000	0.	2.	148.	0.
30.000 - 32.000	0.	0.	22.	0.
32.000 - 32.500	0.	2.	6.	0.
32.500 - 34.000	0.	1.	3.	0.
34.000 - 36.000	0.	1.	4.	0.
36.000 - 38.000	0.	2.	1.	0.
38.000 - 40.000	0.	0.	3.	0.
40.000 - 42.000	0.	0.	1.	0.
42.000 - 44.000	0.	0.	0.	0.
44.000 - 46.000	0.	0.	0.	0.
46.000 - 50.000	0.	0.	0.	0.
50.000 - 55.000	0.	0.	0.	0.

GROSS VEHICLE WEIGHT

NUMBER OF LOAD INTERVALS - 23

LOAD INTERVAL	NUMBER OF VEHICLES WEIGHED			
	TYPE 2D	TYPE 3A	TYPE 3-S2	TYPE 2-S1-2
8.000 - 10.000	125.	0.	0.	0.
10.000 - 13.500	110.	1.	0.	0.
13.500 - 20.000	132.	13.	4.	0.
20.000 - 22.000	28.	5.	16.	0.
22.000 - 24.000	15.	1.	46.	0.

24.000 - 26.000	14.	2.	39.	1.
26.000 - 28.000	5.	3.	23.	1.
28.000 - 30.000	7.	0.	16.	0.
30.000 - 32.000	2.	2.	15.	2.
32.000 - 34.000	1.	0.	8.	0.
34.000 - 36.000	2.	2.	12.	1.
36.000 - 38.000	0.	1.	10.	0.
38.000 - 40.000	1.	2.	6.	2.
40.000 - 45.000	0.	1.	12.	1.
45.000 - 50.000	0.	3.	27.	2.
50.000 - 55.000	0.	1.	33.	5.
55.000 - 60.000	0.	0.	58.	10.
60.000 - 65.000	0.	0.	34.	6.
65.000 - 70.000	0.	0.	22.	4.
70.000 - 72.000	0.	0.	0.	0.
72.000 - 75.000	0.	0.	1.	0.
75.000 - 80.000	0.	0.	5.	0.
80.000 - 85.000	0.	0.	1.	0.

EMPTY VEHICLE WEIGHT

NUMBER OF LOAD INTERVALS - 13

LOAD INTERVAL	NUMBER OF VEHICLES WEIGHED			
	TYPE 2D	TYPE 3A	TYPE 3-S2	TYPE 2-S1-2
4.000 - 6.000	14.	0.	0.	0.
6.000 - 8.000	78.	0.	0.	0.
8.000 - 10.000	143.	4.	0.	0.
10.000 - 12.000	107.	10.	0.	0.
12.000 - 14.000	75.	26.	0.	0.
14.000 - 16.000	50.	47.	2.	0.
16.000 - 18.000	9.	35.	4.	0.
18.000 - 20.000	7.	14.	19.	0.
20.000 - 25.000	4.	23.	290.	3.
25.000 - 30.000	0.	6.	262.	10.
30.000 - 35.000	0.	0.	120.	4.
35.000 - 40.000	0.	0.	24.	0.
40.000 - 45.000	0.	0.	4.	2.

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 2D

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
2.000	.00	.00	4.31	.00	.00	.00

4.000	.00	.00	17.48	.00	.00	.00
6.000	.00	.00	41.79	.00	.00	.00
8.000	.00	.00	63.79	.00	.00	.00
10.000	28.28	21.35	76.08	.00	.00	.00
12.000	42.50	37.58	83.37	.00	.00	.00
14.000	55.46	49.47	89.01	.00	.00	.00
16.000	64.65	59.21	92.85	.00	.00	.00
18.000	73.84	67.08	95.89	.00	.00	.00
20.000	83.03	74.83	98.17	.00	.00	.00
22.000	89.37	82.46	100.00	.00	.00	.00
24.000	92.76	87.81	.00	.00	.00	.00
26.000	95.93	91.27	.00	.00	.00	.00
28.000	97.06	93.89	.00	.00	.00	.00
30.000	98.64	96.09	.00	.00	.00	.00
32.000	99.10	96.96	.00	.00	.00	.00
34.000	99.32	98.14	.00	.00	.00	.00
36.000	99.77	98.87	.00	.00	.00	.00
38.000	99.77	99.18	.00	.00	.00	.00
40.000	100.00	99.42	.00	.00	.00	.00
42.000	100.00	99.77	.00	.00	.00	.00
44.000	100.00	99.77	.00	.00	.00	.00
46.000	100.00	99.96	.00	.00	.00	.00
48.000	.00	100.00	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 3A

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
2.000	.00	.00	.00	1.48	.00	.00
4.000	.00	.00	.00	2.97	.00	.00
6.000	.00	.00	.00	4.45	.00	.00
8.000	.00	.00	.00	14.55	.00	.00
10.000	.00	.00	.00	30.43	.00	.00
12.000	1.54	1.28	.00	45.63	.00	.00
14.000	5.41	4.51	.00	54.93	.00	.00
16.000	16.22	12.97	.00	60.11	.00	.00
18.000	27.03	22.95	.00	65.17	.00	.00
20.000	37.84	32.86	.00	69.17	.00	.00
22.000	51.35	43.88	.00	72.00	.00	.00
24.000	54.05	52.29	.00	74.54	.00	.00
26.000	59.46	55.36	.00	76.60	.00	.00
28.000	67.57	60.50	.00	78.56	.00	.00
30.000	67.57	67.57	.00	80.43	.00	.00
32.000	72.97	67.57	.00	82.02	.00	.00
34.000	72.97	71.60	.00	83.61	.00	.00
36.000	78.38	72.97	.00	85.80	.00	.00
38.000	81.08	75.46	.00	91.08	.00	.00
40.000	86.49	79.21	.00	94.52	.00	.00
42.000	87.57	81.88	.00	97.73	.00	.00

44.000	88.65	86.40	.00	100.00	.00	.00
46.000	90.81	87.36	.00	.00	.00	.00
48.000	94.05	88.25	.00	.00	.00	.00
50.000	97.30	89.73	.00	.00	.00	.00
52.000	98.38	92.11	.00	.00	.00	.00
54.000	99.46	95.03	.00	.00	.00	.00
56.000	100.00	97.51	.00	.00	.00	.00
58.000	.00	98.49	.00	.00	.00	.00
60.000	.00	99.46	.00	.00	.00	.00
62.000	.00	99.95	.00	.00	.00	.00
64.000	.00	100.00	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 3-S2

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
2.000	.00	.00	.00	1.92	.00	.00
4.000	.00	.00	.00	3.83	.00	.00
6.000	.00	.00	.00	8.33	.00	.00
8.000	.00	.00	.00	18.02	.00	.00
10.000	.00	.00	.00	28.20	.00	.00
12.000	.00	.00	.00	38.12	.00	.00
14.000	.08	.07	.00	43.98	.00	.00
16.000	.40	.34	.00	48.45	.00	.00
18.000	.71	.65	.00	52.74	.00	.00
20.000	1.03	.95	.00	57.80	.00	.00
22.000	5.15	3.85	.00	63.79	.00	.00
24.000	17.01	12.56	.00	69.88	.00	.00
26.000	27.06	22.66	.00	75.98	.00	.00
28.000	32.99	30.00	.00	81.67	.00	.00
30.000	37.11	34.73	.00	87.23	.00	.00
32.000	40.98	38.45	.00	92.60	.00	.00
34.000	43.04	41.53	.00	95.39	.00	.00
36.000	46.13	43.60	.00	96.10	.00	.00
38.000	48.71	46.37	.00	96.82	.00	.00
40.000	50.26	48.71	.00	97.54	.00	.00
42.000	51.49	50.11	.00	98.25	.00	.00
44.000	52.73	51.25	.00	98.97	.00	.00
46.000	54.74	52.36	.00	99.68	.00	.00
48.000	57.53	53.91	.00	100.00	.00	.00
50.000	60.31	56.06	.00	.00	.00	.00
52.000	63.71	58.52	.00	.00	.00	.00
54.000	67.11	61.11	.00	.00	.00	.00
56.000	71.80	64.09	.00	.00	.00	.00
58.000	77.78	67.06	.00	.00	.00	.00
60.000	83.76	71.11	.00	.00	.00	.00
62.000	87.27	76.08	.00	.00	.00	.00
64.000	90.77	81.23	.00	.00	.00	.00
66.000	93.66	85.28	.00	.00	.00	.00

68.000	95.93	88.28	.00	.00	.00	.00
70.000	98.20	91.17	.00	.00	.00	.00
72.000	98.20	93.62	.00	.00	.00	.00
74.000	98.37	95.54	.00	.00	.00	.00
76.000	98.71	97.45	.00	.00	.00	.00
78.000	99.23	98.20	.00	.00	.00	.00
80.000	99.74	98.25	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 3-S2

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
82.000	99.85	98.43	.00	.00	.00	.00
84.000	99.95	98.71	.00	.00	.00	.00
86.000	100.00	99.18	.00	.00	.00	.00
88.000	.00	99.64	.00	.00	.00	.00
90.000	.00	99.82	.00	.00	.00	.00
92.000	.00	99.91	.00	.00	.00	.00
94.000	.00	99.98	.00	.00	.00	.00
96.000	.00	100.00	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 2-S1-2

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
2.000	.00	.00	2.23	.00	.00	.00
4.000	.00	.00	4.45	.00	.00	.00
6.000	.00	.00	10.53	.00	.00	.00
8.000	.00	.00	18.60	.00	.00	.00
10.000	.00	.00	30.96	.00	.00	.00
12.000	.00	.00	47.67	.00	.00	.00
14.000	.00	.00	64.38	.00	.00	.00
16.000	.00	.00	76.24	.00	.00	.00
18.000	.00	.00	87.58	.00	.00	.00
20.000	.00	.00	95.02	.00	.00	.00
22.000	.00	.00	96.07	.00	.00	.00
24.000	.00	.00	97.12	.00	.00	.00
26.000	2.86	.44	98.17	.00	.00	.00
28.000	5.71	2.94	99.22	.00	.00	.00
30.000	5.71	5.42	100.00	.00	.00	.00
32.000	11.43	5.71	.00	.00	.00	.00
34.000	11.43	9.18	.00	.00	.00	.00

36.000	14.29	11.43	.00	.00	.00	.00
38.000	14.29	12.26	.00	.00	.00	.00
40.000	20.00	14.29	.00	.00	.00	.00
42.000	21.14	14.29	.00	.00	.00	.00
44.000	22.29	18.66	.00	.00	.00	.00
46.000	24.00	20.66	.00	.00	.00	.00
48.000	26.29	21.58	.00	.00	.00	.00
50.000	28.57	22.61	.00	.00	.00	.00
52.000	34.29	23.97	.00	.00	.00	.00
54.000	40.00	25.76	.00	.00	.00	.00
56.000	48.57	27.55	.00	.00	.00	.00
58.000	60.00	30.47	.00	.00	.00	.00
60.000	71.43	34.89	.00	.00	.00	.00
62.000	78.29	39.27	.00	.00	.00	.00
64.000	85.14	45.44	.00	.00	.00	.00
66.000	90.86	53.05	.00	.00	.00	.00
68.000	95.43	61.66	.00	.00	.00	.00
70.000	100.00	70.21	.00	.00	.00	.00
72.000	.00	75.79	.00	.00	.00	.00
74.000	.00	80.85	.00	.00	.00	.00
76.000	.00	85.76	.00	.00	.00	.00
78.000	.00	89.93	.00	.00	.00	.00
80.000	.00	93.43	.00	.00	.00	.00

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 2-S1-2

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
82.000	.00	96.72	.00	.00	.00	.00
84.000	.00	100.00	.00	.00	.00	.00
86.000	.00	100.00	.00	.00	.00	.00

TRUCK TYPE	PAYLOAD PER TRUCK		18-KIP AXLES PER TRUCK	
	PRESENT	PROPOSED	PRESENT	PROPOSED
2D	3.97	5.30	.08	.14
3A	9.71	11.69	.43	.66
3-S2	15.53	18.21	.60	.97
2-S1-2	23.42	31.56	.86	2.02

YEAR	18-KIP ESAL RATIO (PROPOSED/PRESENT)	YEAR	18-KIP ESAL RATIO (PROPOSED/PRESENT)
1	1.391	11	1.390

2	1.391	12	1.390
3	1.390	13	1.390
4	1.390	14	1.390
5	1.390	15	1.390
6	1.390	16	1.390
7	1.390	17	1.390
8	1.390	18	1.390
9	1.390	19	1.390
10	1.390	20	1.390

AVERAGE PAVEMENT AGE WHEN 25 PERCENT OF MILEAGE IS ALREADY OVERLAID - 19.00 YEARS
AVERAGE PAVEMENT AGE WHEN 75 PERCENT OF MILEAGE IS ALREADY OVERLAID - 28.00 YEARS
AVERAGE AGE AT TERMINAL PSI FOR EXISTING DESIGN ---------- 23.00 YEARS
STANDARD DEVIATION OF THE SURVIVOR CURVE ---------- 6.68 YEARS
PERCENT OF TOTAL LANE MILES IN POTTS
(BEGINNING OF ANALYSIS PERIOD) ---------- 1.07

LANE-MILES FROM GIVEN AGE SLICE DUE FOR TIMELY OVERLAY IN GIVEN ANALYSIS YEAR

VALUE	LOSS RATE	PAVEMENT AGE AT BEGINNING OF A.P.	TOTAL	INTO POTTS	ANALYSIS YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13
526.	2.00	1	217.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
499.	2.00	2	175.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
493.	2.00	3	223.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
474.	2.00	4	242.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	14.4
347.	2.00	5	240.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	14.3	16.2
306.	2.00	6	175.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	10.4	11.8	13.0
283.	2.00	7	158.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	9.4	10.6	11.8	12.7
262.	2.00	8	132.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	7.9	8.9	9.8	10.6	11.3
226.	2.00	9	162.0	.0	.0	.0	.0	.0	.0	.0	.0	9.6	10.9	12.1	13.1	13.8	14.3
203.	2.00	10	102.0	.0	.0	.0	.0	.0	.0	.0	6.1	6.9	7.6	8.2	8.7	9.0	9.1
191.	2.00	11	99.0	.0	.0	.0	.0	.0	.0	5.9	6.7	7.4	8.0	8.4	8.7	8.8	8.7
180.	2.00	12	53.0	.0	.0	.0	.0	.0	3.2	3.6	3.9	4.3	4.5	4.7	4.7	4.7	4.5
170.	2.00	13	33.0	.0	.0	.0	.0	2.0	2.2	2.5	2.7	2.8	2.9	2.9	2.9	2.8	2.7
160.	2.00	14	43.0	.0	.0	.0	2.6	2.9	3.2	3.5	3.7	3.8	3.8	3.8	3.7	3.5	3.2
151.	2.00	15	33.0	.0	.0	2.0	2.2	2.5	2.7	2.8	2.9	2.9	2.9	2.8	2.7	2.5	2.2
142.	2.00	16	20.0	.0	1.2	1.3	1.5	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.2
134.	2.00	17	33.0	2.0	2.2	2.5	2.7	2.8	2.9	2.9	2.9	2.8	2.7	2.5	2.2	2.0	.0
126.	2.00	18	26.0	3.3	1.9	2.1	2.2	2.3	2.3	2.3	2.2	2.1	1.9	1.8	1.5	.0	.0
119.	2.00	19	20.0	4.0	1.6	1.7	1.8	1.8	1.8	1.7	1.6	1.5	1.3	1.2	.0	.0	.0
112.	2.00	20	14.0	3.9	1.2	1.2	1.2	1.2	1.2	1.1	1.0	.9	.8	.0	.0	.0	.0
106.	2.00	21	4.0	1.5	.4	.4	.4	.3	.3	.3	.3	.2	.0	.0	.0	.0	.0
100.	2.00	22	6.0	2.7	.5	.5	.5	.5	.4	.4	.4	.0	.0	.0	.0	.0	.0
94.	2.00	23	4.0	2.2	.4	.3	.3	.3	.3	.2	.0	.0	.0	.0	.0	.0	.0
89.	2.00	24	2.0	1.3	.2	.2	.1	.1	.1	.0	.0	.0	.0	.0	.0	.0	.0
84.	2.00	25	4.0	2.9	.3	.3	.3	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0
		TOTALS		23.8	9.9	12.5	15.8	18.6	22.3	29.0	36.1	47.1	57.0	68.3	80.6	96.8	113.5
AVERAGE AGE AT TERMINAL PSI					19.77	20.09	20.32	20.73	20.84	20.68	20.68	20.49	20.65	20.72	20.82	20.82	20.91

VALUE IN THOUSANDS OF DOLLARS LOSS RATE IN PERCENT PER YEAR

LANE-MILES FROM GIVEN AGE SLICE DUE FOR TIMELY OVERLAY IN GIVEN ANALYSIS YEAR

PAVEMENT AGE AT BEGINNING OF A.P.	ANALYSIS YEAR 14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	.0	.0	12.9	14.6	16.2	17.5	18.5	19.1	19.3	19.1	18.5	17.5	16.2	14.6	12.9
2	.0	10.4	11.8	13.0	14.1	14.9	15.4	15.6	15.4	14.9	14.1	13.0	11.8	10.4	.0
3	13.3	15.0	16.6	18.0	19.0	19.7	19.9	19.7	19.0	18.0	16.6	15.0	13.3	.0	.0
4	16.3	18.0	19.5	20.6	21.3	21.6	21.3	20.6	19.5	18.0	16.3	14.4	.0	.0	.0
5	17.9	19.3	20.5	21.2	21.4	21.2	20.5	19.3	17.9	16.2	14.3	.0	.0	.0	.0
6	14.1	14.9	15.4	15.6	15.4	14.9	14.1	13.0	11.8	10.4	.0	.0	.0	.0	.0
7	13.5	13.9	14.1	13.9	13.5	12.7	11.8	10.6	9.4	.0	.0	.0	.0	.0	.0
8	11.6	11.8	11.6	11.3	10.6	9.8	8.9	7.9	.0	.0	.0	.0	.0	.0	.0
9	14.4	14.3	13.8	13.1	12.1	10.9	9.6	.0	.0	.0	.0	.0	.0	.0	.0
10	9.0	8.7	8.2	7.6	6.9	6.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
11	8.4	8.0	7.4	6.7	5.9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
12	4.3	3.9	3.6	3.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
13	2.5	2.2	2.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14	2.9	2.6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
15	2.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
16	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
17	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
18	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
19	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
21	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
22	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
23	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
24	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTALS	130.1	143.1	157.4	158.7	156.4	149.3	140.0	125.9	112.4	96.6	79.8	60.0	41.2	25.0	12.9
AVERAGE AGE AT TERMINAL PSI	21.17	21.51	21.76	22.48	23.17	23.79	24.44	25.00	25.66	26.29	26.92	27.44	27.93	28.42	29.00

VALUE IN THOUSANDS OF DOLLARS LOSS RATE IN PERCENT PER YEAR

PERFORMANCE TABLE
PRESENT REGULATIONS

LANE MILES DUE OVERLAY	LANE MILES OVERLAID	YEAR OF OVERLAY	OVERLAY DESIGN D	OVERLAY THICKNESS	PSI AT BEGINNING OF ANALYSIS PERIOD	PSI AT END OF ANALYSIS PERIOD	REMAINING LIFE (MILLION 18-KIP EAL)	OVERLAY COST ($/LANE MILE)
9.9	8.6	1.00	8.58	4.46	2.63	2.62	.329	34105.
12.5	10.8	2.00	8.56	4.41	2.75	2.74	.644	33746.
15.8	13.6	3.00	8.55	4.38	2.86	2.85	.947	33488.
18.6	16.0	4.00	8.53	4.32	2.96	2.96	1.230	33036.

22.3	19.3	5.00	8.52	4.30	3.06	3.06	1.516	32914.
29.0	25.1	6.00	8.53	4.32	3.16	3.16	1.813	33081.
36.1	31.2	7.00	8.53	4.33	3.26	3.25	2.095	33090.
47.1	40.7	8.00	8.54	4.35	3.36	3.35	2.389	33296.
57.0	49.3	9.00	8.53	4.33	3.44	3.44	2.646	33123.
68.3	59.0	10.00	8.53	4.32	3.52	3.52	2.903	33038.
80.6	69.7	11.00	8.52	4.31	3.60	3.60	3.151	32934.
96.8	83.8	12.00	8.52	4.31	3.68	3.68	3.405	32934.
113.5	98.2	13.00	8.52	4.29	3.75	3.76	3.641	32840.
130.1	112.5	14.00	8.50	4.26	3.81	3.83	3.846	32564.
143.1	123.8	15.00	8.48	4.21	3.86	3.90	4.030	32205.
157.4	136.1	16.00	8.47	4.18	3.91	3.97	4.218	31942.
158.7	137.2	17.00	8.43	4.08	3.94	4.04	4.328	31230.
156.4	135.3	18.00	8.40	4.00	3.97	4.10	4.432	30566.
149.3	129.1	19.00	8.37	3.92	4.00	4.15	4.540	29991.
140.0	121.1	20.00	8.34	3.84	4.02	4.20	4.636	29408.
125.9	.0	21.00	.00	.00	4.05	2.61	.184	0.
112.4	.0	22.00	.00	.00	4.07	2.70	.357	0.
96.6	.0	23.00	.00	.00	4.09	2.79	.520	0.
79.8	.0	24.00	.00	.00	4.11	2.88	.675	0.
60.0	.0	25.00	.00	.00	4.13	2.96	.823	0.
41.2	.0	26.00	.00	.00	4.15	3.03	.965	0.
25.0	.0	27.00	.00	.00	4.16	3.10	1.101	0.
12.9	.0	28.00	.00	.00	4.18	3.17	1.227	0.

PERFORMANCE TABLE
PROPOSED REGULATIONS

LANE MILES DUE OVERLAY	LANE MILES OVERLAID	YEAR OF OVERLAY	OVERLAY DESIGN D	OVERLAY THICKNESS	PSI AT BEGINNING OF ANALYSIS PERIOD	PSI AT END OF ANALYSIS PERIOD	REMAINING LIFE (MILLION 18-KIP EAL)	OVERLAY COST ($/LANE MILE)
9.9	8.9	.72	9.06	5.66	2.63	2.58	.329	43300.
12.5	11.2	1.45	9.04	5.59	2.75	2.67	.643	42773.
15.8	14.1	2.18	9.01	5.54	2.86	2.75	.947	42352.
18.6	16.6	2.91	8.98	5.46	2.96	2.83	1.230	41735.
22.3	20.0	3.65	8.97	5.42	3.06	2.91	1.516	41459.
29.0	26.0	4.39	8.97	5.42	3.16	2.99	1.812	41484.
36.1	32.4	5.13	8.96	5.41	3.26	3.06	2.095	41348.
47.1	42.2	5.88	8.97	5.41	3.36	3.13	2.388	41416.
57.0	51.1	6.63	8.95	5.37	3.44	3.21	2.645	41098.
68.3	61.2	7.39	8.94	5.34	3.52	3.28	2.902	40873.
80.6	72.3	8.15	8.92	5.31	3.60	3.35	3.150	40630.
96.8	86.9	8.91	8.92	5.29	3.68	3.42	3.404	40496.
113.5	101.8	9.68	8.91	5.26	3.75	3.48	3.640	40267.
130.1	116.8	10.45	8.88	5.21	3.81	3.55	3.845	39854.
143.1	128.4	11.22	8.86	5.15	3.86	3.61	4.029	39360.
157.4	141.2	12.00	8.84	5.09	3.91	3.67	4.217	38965.
158.7	142.4	12.78	8.79	4.98	3.94	3.73	4.327	38113.
156.4	140.3	13.56	8.75	4.88	3.97	3.79	4.431	37314.
149.3	133.9	14.35	8.71	4.79	4.00	3.85	4.539	36607.
140.0	125.6	15.14	8.68	4.69	4.02	3.91	4.635	35856.
125.9	113.0	15.93	8.65	4.61	4.05	3.96	4.737	35284.

112.4	100.8	16.73	8.61	4.52	4.07	4.02	4.820	34612.
96.6	86.7	17.53	8.58	4.44	4.09	4.07	4.901	33978.
79.8	71.6	18.33	8.54	4.36	4.11	4.11	4.978	33369.
60.0	53.8	19.14	8.52	4.30	4.13	4.16	5.065	32861.
41.2	37.0	19.95	8.49	4.23	4.15	4.20	5.151	32386.
25.0	.0	20.76	.00	.00	4.16	2.59	.157	0.
12.9	.0	21.58	.00	.00	4.18	2.68	.315	0.

P O T T S T A B L E
P R E S E N T R E G U L A T I O N S

ANALYSIS YEAR	LANE MILES IN POTTS	LANE MILES OVERLAID FROM POTTS	OVERLAY DESIGN D	OVERLAY THICKNESS	PSI AT END OF ANALYSIS PERIOD	OVERLAY COST ($/LANE-MILE)
1	25.0	.1	7.65	4.12	2.63	31522.
2	26.5	.2	7.68	4.19	2.76	32054.
3	28.4	.2	7.70	4.26	2.87	32583.
4	30.6	.3	7.73	4.33	2.93	33113.
5	33.3	.3	7.76	4.40	3.09	33644.
6	36.8	.4	7.79	4.47	3.20	34175.
7	41.1	.5	7.81	4.54	3.29	34707.
8	46.8	.7	7.84	4.61	3.38	35239.
9	53.7	.8	7.87	4.68	3.47	35772.
10	61.9	1.0	7.90	4.75	3.56	36306.
11	71.7	1.2	7.93	4.82	3.64	36841.
12	83.4	1.4	7.95	4.89	3.71	37378.
13	97.1	1.6	7.98	4.96	3.79	37912.
14	112.8	1.9	8.01	5.03	3.86	38448.
15	130.1	2.1	8.04	5.10	3.92	38984.
16	149.0	2.3	8.07	5.17	3.99	39524.
17	168.2	2.3	8.09	5.24	4.05	40063.
18	187.1	2.3	8.12	5.31	4.10	40602.
19	205.1	2.2	8.15	5.38	4.16	41143.
20	222.0	2.0	8.18	5.45	4.20	41684.

P O T T S T A B L E
P R O P O S E D R E G U L A T I O N S

ANALYSIS YEAR	LANE MILES IN POTTS	LANE MILES OVERLAID FROM POTTS	OVERLAY DESIGN D	OVERLAY THICKNESS	PSI AT END OF ANALYSIS PERIOD	OVERLAY COST ($/LANE-MILE)
1	24.7	.1	8.11	5.28	2.62	40401.
2	25.8	.1	8.14	5.35	2.74	40941.
3	29.0	.4	8.17	5.42	2.86	41481.
4	31.0	.2	8.20	5.49	2.97	42023.
5	33.7	.3	8.23	5.56	3.07	42565.
6	41.3	.9	8.25	5.64	3.17	43108.
7	46.5	.6	8.28	5.71	3.26	43652.
8	52.8	.8	8.31	5.78	3.36	44197.

9	69.1	2.0	8.34	5.85	3.44	44743.
10	79.5	1.2	8.37	5.92	3.53	45289.
11	91.5	1.4	8.40	5.99	3.61	45837.
12	119.1	3.3	8.43	6.06	3.69	46385.
13	133.7	1.7	8.45	6.14	3.76	46934.
14	148.0	1.7	8.48	6.21	3.83	47484.
15	161.8	1.6	8.51	6.28	3.90	48036.
16	186.2	2.9	8.54	6.35	3.97	48588.
17	196.5	1.2	8.57	6.42	4.03	49141.
18	205.4	1.1	8.60	6.50	4.09	49695.
19	212.7	.9	8.63	6.57	4.15	50250.
20	222.0	1.1	8.66	6.64	4.20	50806.

U N D I S C O U N T E D C O S T S
(MILLIONS OF DOLLARS)

YEAR IN ANALYSIS PERIOD	MAINTENANCE		OVERLAY	
	PRESENT	PROPOSED	PRESENT	PROPOSED
1	.207	.295	.296	.389
2	.263	.415	.370	.485
3	.335	.559	.464	1.309
4	.418	.715	.539	.839
5	.506	.849	.645	1.092
6	.589	.929	.843	3.128
7	.657	.955	1.052	2.129
8	.704	.944	1.379	2.536
9	.729	.907	1.662	6.544
10	.738	.854	1.986	4.157
11	.737	.798	2.339	4.719
12	.731	.749	2.811	10.709
13	.722	.684	3.286	5.508
14	.712	.647	3.737	5.317
15	.703	.633	4.067	4.982
16	.697	.651	4.438	8.637
17	.697	.692	4.378	3.550
18	.709	.782	4.226	2.999
19	.736	.914	3.961	2.433
20	.781	1.092	3.646	3.022
TOTALS	12.370	15.064	46.124	74.483

S A L V A G E V A L U E
(MILLIONS OF DOLLARS)

	ANALYSIS PERIOD	
	BEGINNING	END
PRESENT	-761.882	-540.917
PROPOSED	-761.882	-553.862
	DELTA	-12.944

STOP		0	0	.00	.00	.00	.00	.00		

SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

SECTION NUMBER	SECTION IDENTIFIER	LANE MILES	UNDISCOUNTED DELTA COST	UNDISCOUNTED COST RATIO	UNDISCOUNTED DELTA SALVAGE VALUE	PRESENT WORTH DELTA COST	PRESENT WORTH COST RATIO	UNIFORM ANNUAL COST DELTA COST	UNIFORM ANNUAL COST COST RATIO	RATIO OF REMAINING LIFE PROPOSED/PRESENT
1	INTFLX A	1101.	6.003	1.14	1.737	6.053	1.24	.528	1.24	1.01

SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

SECTION NUMBER	SECTION IDENTIFIER	LANE MILES	UNDISCOUNTED DELTA COST	UNDISCOUNTED COST RATIO	UNDISCOUNTED DELTA SALVAGE VALUE	PRESENT WORTH DELTA COST	PRESENT WORTH COST RATIO	UNIFORM ANNUAL COST DELTA COST	UNIFORM ANNUAL COST COST RATIO	RATIO OF REMAINING LIFE PROPOSED/PRESENT
1	INTRIG A	2220.	31.052	1.53	-12.944	13.889	1.51	1.211	1.51	1.39
TOTAL		2220.	31.052		-12.944	13.889		1.211		

ALL COSTS ARE IN MILLIONS OF DOLLARS

APPENDIX C

ILLI-PAVE: SCREENS

(EXAMPLE)

MAIN DESIGN MENU

ILLI-PAVE ALGORITHMS

FOR DESIGN OF FLEXIBLE PAVEMENTS

Solve for:

1 Asphalt Strain
2 Subgrade Deviator Stress
3 Subgrade Deviator Stress Ratio
4 Subgrade Vertical Strain
5 Surface Deflection
6 Subgrade Deflection
7 Deflection Area

8 Branch to Analysis Algorithm Menu

0 Return to DOS

Selection:

DESIGN ALGORITHM #1

ILLI-PAVE Algorithm #1 : Asphalt Bottom Layer Strain (micron-in/in)

log eac=
2.3436+.1289Tac-.5135(log Thac)/Tac-.0007(log Eac)Tac-.0488(log Eri)

Input Values:

1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.]
Tac =2.5
2. Thickness of aggregate base course (inches) [Algorithm range: 0 - 24 in.]
Thac=11.5
3. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1400]
Eac =700
4. "Breakpoint" resilient modulus of the subgrade (ksi) [Algor. 1 - 12.34]
Eri =5.4

Solution: 3.86529

F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

DESIGN ALGORITHM #2

ILLI-PAVE Algorithm #2 : Deviator Stress At Top Of Subgrade (psi)
log σd = 1.7694-.0735Tac-.0022Tbse-.2539(log Eac)+.0223Eri
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 0 - 24 in.] Tbse= 11.5000 3. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1400] Eac = 780.0000 4. "Breakpoint" resilient modulus of the subgrade (ksi) [Algor. 1 - 12.34] Eri = 5.4000
Solution: .78661
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

DESIGN ALGORITHM #3

ILLI-PAVE Algorithm #3 : Subgrade Deviator Stress/Compressive Strength Ratio
log Sr = 0.3058+.0560Tac-.0022Tbse-.0435(log Eac)Tac-.4242(log Eri)
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 0 - 24 in.] Tbse= 11.5000 3. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1400] Eac = 780.0000 4. "Breakpoint" resilient modulus of the subgrade (ksi) [Algor. 1 - 12.34] Eri = 5.4000
Solution: .25946
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

DESIGN ALGORITHM #4

ILLI-PAVE Algorithm #4 : Vertical Strain At Top Of Subgrade (micron-in/in)
log ez = 4.5040-.8738Tac-.0334Tbse-.3267(log Eac)-.0231Eri
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 0 - 24 in.] Tbse= 11.5000 3. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1400] Eac = 700.0000 4. "Breakpoint" resilient modulus of the subgrade (ksi) [Algor. 1 - 12.34] Eri = 5.4000
Solution: 5.12301
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

DESIGN ALGORITHM #5

ILLI-PAVE Algorithm #5 : Surface Deflection At Point Of Loading (mils)
log D0 = 1.5652+.0465Tac-.5637(log Tbse)/Tac-.0464(log Eac)Tac-.2079(log Eri)
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 0 - 24 in.] Tbse= 11.5000 3. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1400] Eac = 700.0000 4. "Breakpoint" resilient modulus of the subgrade (ksi) [Algor. 1 - 12.34] Eri = 5.4000
Solution: 1.58333
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

DESIGN ALGORITHM #6

ILLI-PAVE Algorithm #6 : Subgrade Deflection Under The Point Of Loading (mils)
log Do = 2.0169+.0375Tac-1.035(log Thac)/Tac-.0405(log Eac)Tac-.2425(log Eri)
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 0 - 24 in.] Thac= 11.5000 3. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1900] Eac = 700.0000 4. "Breakpoint" resilient modulus of the subgrade (ksi) [Algor. 1 - 12.34] Eri = 5.9000
Solution: .95042
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

DESIGN ALGORITHM #7

ILLI-PAVE Algorithm #7 : Deflection Basin Parameter 6(D0+2*D1+2*D2+D3)/D0
AREA = 13.2675-1.3314Tac+0.6536(logThac)/Tac+1.0575(logEac)Tac-3.7945(logEri)
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 0 - 24 in.] Thac= 11.5000 3. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1900] Eac = 700.0000 4. "Breakpoint" resilient modulus of the subgrade (ksi) [Algor. 1 - 12.34] Eri = 5.9000
Solution: 29.50469
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

ANALYSIS MAIN MENU

ILLI-PAVE ALGORITHMS

FOR ANALYSIS OF FLEXIBLE PAVEMENTS

Solve for:

1 Subgrade Resilient Modulus (from deflection at point of loading)
2 Subgrade Resilient Modulus (from deflection basin)
3 Asphalt Strain (method 1)
4 Asphalt Strain (method 2)
5 Asphalt Strain (method 3)
6 Asphalt Strain (method 4)
7 Subgrade Deviator Stress
8 Subgrade Deviator Stress (includes deflection basin as input)
9 Subgrade Vertical Strain

0 Return to Design Algorithm Menu

Selection:

ANALYSIS ALGORITHM #1

ILLI-PAVE Algorithm #1 : Subgrade Resilient Modulus (Msi) (defl at pt of load)
log Eri= 7.6163+.1764Tac-2.1434(log Thee)/Tac-.1778(log Eac)Tac-3.0823(log BD)
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 0 - 24 in.] Thee= 11.5000 3. Resilient modulus of the asphalt layer (Msi) [Algorithm range: 0 - 1900] Eac = 700.0000 4. Surface deflection at the point of loading (mils) [Algor. range: 7 - 163] BD = 1.5093
Solution: 4.25857
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

ANALYSIS ALGORITHM #2

ILLI-PAVE Algorithm #2 : Subgrade Resilient Modulus (ksi) (deflection basin)
log Eri= 5.8931+.1107Tac-.8656(log Eac)Tac-1.9524(log D0)-.1488AREA
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1400] Eac = 700.0000 3. Surface deflection at the point of loading (mils) [Algor. range: 7 - 153] D0 = 1.5093 4. Deflection basin parameter, 6(D0+2*D1+2*D2+D3)/D0 [Algor. range 10 - 30] AREA= 29.6047
Solution: .05887
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

ANALYSIS ALGORITHM #3

ILLI-PAVE Algorithm #3 : Asphalt Bottom Layer Strain (micron-in/in) (method 1)
log eac= 2.2469+.1233Tac-.06681(log Eac)Tac+.2912(log D0)
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1400] Eac = 700.0000 3. Surface deflection at the point of loading (mils) [Algor. range: 7 - 153] D0 = 1.5093
Solution: 4.77197
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

ANALYSIS ALGORITHM #4

ILLI-PAVE Algorithm #4 : Asphalt Bottom Layer Strain (micron-in/in) (method 2)
log eac= 2.8830+.8254Tac+.8137(log D0)-.8365AREA
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Surface deflection at the point of loading (mils) [Algor. range: 7 - 163] D0 = 1.5093 3. Deflection basin parameter, 6(D0+2*D1+2*D2+D3)/D0 [Algor. range 10 - 30] AREA= 29.6047
Solution: 4.85887
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

ANALYSIS ALGORITHM #5

ILLI-PAVE Algorithm #5 : Asphalt Bottom Layer Strain (micron-in/in) (method 3)
log eac= .9182+1.1126(log D0)
Input Values: 1. Surface deflection at the point of loading (mils) [Algor. range: 7 - 163] D0 = 1.5093
Solution: 3.92836
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

ANALYSIS ALGORITHM #6

ILLI-PAVE Algorithm #6 : Asphalt Bottom Layer Strain (micron-in/in) (method 4)
log eac= 2.0044+.7072(log D0)-.8316AREA
Input Values: 1. Surface deflection at the point of loading (mils) [Algor. range: 7 - 153] D0 = 1.5093 2. Deflection basin parameter, 6(D0+2*D1+2*D2+D3)/D0 [Algor. range 18 - 30] AREA= 29.6047
Solution: 4.22000
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

ANALYSIS ALGORITHM #7

ILLI-PAVE Algorithm #7 : Subgrade Deviator Stress (psi) (point loading)
log sd = 4.8648-.1176Tac-.0274Tbac-.4879(log Eac)-.9419(log D0)
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 0 - 24 in.] Tbac= 11.5000 3. Resilient modulus of the asphalt layer (ksi) [Algorithm range: 0 - 1400] Eac = 700.0000 4. Surface deflection at the point of loading (mils) [Algor. range: 7 - 153] D0 = 1.5093
Solution: .83433
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

ANALYSIS ALGORITHM #8

ILLI-PAVE Algorithm #8 : Subgrade Deviator Stress (psi) (defl basin parameter)
log sd = 2.1879-.0197(Tac+Tbac)-.1277(log D0)-.0537(AREA
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 8 - 24 in.] Tbac= 11.5000 3. Surface deflection at the point of loading (mils) [Algor. range: 7 - 163] D0 = 1.5093 4. Deflection basin parameter, 6(D0+2*D1+2*D2+D3)/D0 [Algor. range 18 - 30] AREA= 29.6047
Solution: 1.30965
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

ANALYSIS ALGORITHM #9

ILLI-PAVE Algorithm #9 : Subgrade Vertical Strain (micron-in/in)
log ez = 1.4457-.0158Tac-.0265Tbac+1.2558 log D0
Input Values: 1. Thickness of the asphalt layer (inches) [Algorithm range maximum: 8 in.] Tac = 2.5000 2. Thickness of aggregate base course (inches) [Algorithm range: 8 - 24 in.] Tbac= 11.5000 3. Surface deflection at the point of loading (mils) [Algor. range: 7 - 163] D0 = 1.5093
Solution: 5.85523
F1: Return to main menu, F2: Skip to a field, CR: Accept value and continue

APPENDIX D

VESYS3AM

1. INTERACTIVE INPUT PROCESSOR
2. INPUT/OUTPUT (EXAMPLE)

DATA INPUT PROGRAM FOR 'VESYS3AM'

```
10 'Data Input Routine For VESYS3AM Input File
20 '  ****** VESINP ******  by R. Raciborski
30 'Creates Sequential File &/or Receives Data From Keyboard
35 OPTION BASE 1
40 DIM RAD(4,6),DPT(4,6),LTH(7),PSN(7),TMP(4,6),MDS(7,4,6),CEV(4,6),K1C(4,6),K2C(4,6),
   CCG(7,4,6),CCA(7,4,6),TDR(5,6),ADT(5,6)
50 ON ERROR GOTO 3050
52 R1$="-999":S1=-999:R2$="ENTER CORRECT VALUE: "
54 R3$="====----====":R4$="E n d  o f  d a t a  e n t r y"
60 INPUT"ENTER FILE NAME FOR INPUT: ",NAMF$
70 OPEN NAMF$ FOR INPUT AS #1
80 PRINT" f i l e   e x i s t s":CLOSE:INPUT"Press enter...",R$:GOTO 60
90 OPEN NAMF$ FOR OUTPUT AS #1
95 CLS:VIEW PRINT:INPUT"FILE OPENED TO RECEIVE DATA (press enter...)",R$
96 GOSUB 2800
100 PRINT:INPUT"ENTER HEADING TO BE PRINTED (IF ANY): ",TITLE$
102 PRINT #1,"TITLE"
105 V=LEN(TITLE$)
110 FOR I=1 TO 6
112 PRINT #1,LEFT$(TITLE$,12);
114 V=V-12:IF V<0 THEN V=0
115 IF V=0 THEN PRINT #1,""
116 TITLE$=RIGHT$(TITLE$,V)
118 NEXT I
120 PRINT
130 INPUT"TYPE OF ANALYSIS (1 - 3): ",TEMP$
135 DE=1!:GOSUB 2950
140 TYP=DE:IF TEMP$=R1$ THEN TYP=COR
145 PRINT #1,USING "TYPE     #.";TYP
150 INPUT"LOG OF THE NUMBER OF LOAD REPET. AT WHICH PERM. DEF. PROPERTIES ARE
COMPUTED: ",TEMP$
155 DE=15!:GOSUB 2950
160 UNL=DE:IF TEMP$=R1$ THEN UNL=COR
165 PRINT #1,USING"UNLOAD  ###.##";UNL
170 INPUT"RADIAL VALUE OF LOADING (inches): ",TEMP$
175 DE=6!:GOSUB 2950
180 RAD=DE:IF TEMP$=R1$ THEN RAD=COR
185 PRINT #1,USING"RADIUS       ##.##";RAD
190 INPUT"DEPTH AT WHICH STRAIN IS TAKEN FOR DETERM. OF CRACK INDEX: ",TEMP$
195 DE=1!:GOSUB 2950
200 DEP=DE:IF TEMP$=R1$ THEN DEP=COR
205 PRINT #1,USING"ZCRACK       ##.#";DEP
210 INPUT"NUMBER OF RADIAL POINTS OF INTEREST (max.20): ",TEMP$
215 DE=1!:GOSUB 2950
220 NRP=DE:IF TEMP$=R1$ THEN NRP=COR
225 PRINT #1,USING"NRPOINTS       ##.";NRP
230 PRINT #1,"RPOINTS"
235 PRINT:PRINT"RADIAL DISTANCES FROM THE CENTER OF THE LOAD:"
240 FOR I=1 TO INT((NRP-1)/6+1)
245 FOR J=1 TO 6
250 INPUT TEMPO$
```

```
255 RAD(I,J)=VAL(TEMPO$):IF TEMPO$=R1$ THEN PRINT ELSE 265:INPUT R2$,COR
260 IF TEMPO$=R1$ THEN J=J-1 ELSE 265:RAD(I,J)=COR:IF J=0 THEN I=I-1 ELSE
265:J=6:RAD(I,J)=COR
265 IF (I-1)*6+J=NRP THEN J=6
270 NEXT J
275 PRINT:NEXT I
277 PRINT R3$:INPUT R$
278 IF R$=R1$ THEN INPUT R2$,COR
279 IF R$=R1$ THEN J=J-1 ELSE 280:RAD(I,J)=COR:IF J=0 THEN I=I-1 ELSE 280:J=6:RAD(I,J)=COR
280 FOR I=1 TO INT((NRP-1)/6+1)
285 FOR J=1 TO 6
290 PRINT #1,USING" ##.# ";RAD(I,J);
295 IF (I-1)*6+J=NRP THEN J=6
300 NEXT J
305 PRINT #1,"":NEXT I
310 PRINT:INPUT "NUMBER OF Z POINTS OF INTEREST (max.20): ",TEMP$
315 DE=1!:GOSUB 2950
320 NZP=DE:IF TEMP$=R1$ THEN NZP=COR
325 PRINT #1,USING"NZPOINTS ##.";NZP
330 PRINT #1,"ZPOINTS"
335 PRINT:PRINT"DEPTHS AT WHICH RESPONSE INFO IS DESIRED:"
340 FOR I=1 TO INT((NZP-1)/6+1)
345 FOR J=1 TO 6
350 INPUT TEMPO$
355 DPT(I,J)=VAL(TEMPO$):IF TEMPO$=R1$ THEN PRINT ELSE 365:INPUT R2$,COR
360 IF TEMPO$=R1$ THEN J=J-1 ELSE 365:DPT(I,J)=COR:IF J=0 THEN I=I-1 ELSE
365:J=6:DPT(I,J)=COR
365 IF (I-1)*6+J=NZP THEN J=6
370 NEXT J
375 PRINT:NEXT I
377 PRINT R3$:INPUT R$
378 IF R$=R1$ THEN INPUT R2$,COR
379 IF R$=R1$ THEN J=J-1 ELSE 380:DPT(I,J)=COR:IF J=0 THEN I=I-1 ELSE 380:J=6:DPT(I,J)=COR
380 FOR I=1 TO INT((NZP-1)/6+1)
385 FOR J=1 TO 6
390 PRINT #1,USING" ##.# ";DPT(I,J);
395 IF (I-1)*6+J=NZP THEN J=6
400 NEXT J
405 PRINT #1,"":NEXT I
410 PRINT:INPUT"NUMBER OF LAYERS IN THE PAVEMENT SYSTEM (max.7): ",TEMP$
415 DE=1!:GOSUB 2950
420 NLA=DE:IF TEMP$=R1$ THEN NLA=COR
425 PRINT #1,USING"NLAYER #.";NLA
430 PRINT #1,"THICK"
435 PRINT:PRINT"THICKNESS OF CONSECUTIVE LAYERS (start from TOP), inches:"
440 FOR I=1 TO NLA
445 IF I=6 THEN PRINT
450 INPUT TEM$
455 LTH(I)=VAL(TEM$):IF TEM$=R1$ THEN PRINT ELSE 465:INPUT R2$,COR
460 IF TEM$=R1$ THEN I=I-1 ELSE 465:LTH(I)=COR
465 PRINT #1,USING" ##.# ";LTH(I);
470 IF I=>6 THEN PRINT #1,""
473 IF I=NLA THEN PRINT #1,""
475 PRINT:NEXT I
477 PRINT R3$:INPUT R$
478 IF R$=R1$ THEN INPUT R2$,COR
```

```
470 IF R$=R1$ THEN I=I-1 ELSE 480:LTH(I)=COR:PRINT #1,USING"  ##.#    ";LTH(I)
480 PRINT #1,"POISSON"
485 PRINT:PRINT"POISSON'S RATIO OF CONSECUTIVE LAYER MATERIALS (start from TOP):"
490 FOR I=1 TO NLA
495 IF I=6 THEN PRINT
500 INPUT TEM$
505 PSN(I)=VAL(TEM$):IF TEM$=R1$ THEN PRINT ELSE 515:INPUT R2$,COR
510 IF TEM$=R1$ THEN I=I-1 ELSE 515:PSN(I)=COR
515 PRINT #1,USING"  .##    ";PSN(I);
520 IF I=>6 THEN PRINT #1,""
523 IF I=NLA THEN PRINT #1,""
525 NEXT I
527 PRINT R3$:INPUT R$
528 IF R$=R1$ THEN INPUT R2$,COR
529 IF R$=R1$ THEN I=I-1 ELSE 530:PSN(I)=COR:PRINT #1,USING"  .##    ";PSN(I)
530 PRINT:INPUT"NUMBER OF TEMPERATURE INTERVALS (SEASONS) WITHIN A YEAR (max.24):
";TEMP$
535 DE=1!:GOSUB 2950
540 NTS=DE:IF TEMP$=R1$ THEN NTS=COR
545 PRINT #1,USING"NTEMPS      ##.";NTS
550 PRINT #1,"TEMPS"
555 PRINT:PRINT"AVERAGE TEMPERATURE (F) FOR CORRESPONDING TIME INTERVALS (within a
year):"
560 FOR I=1 TO INT((NTS-1)/6+1)
565 FOR J=1 TO 6
570 INPUT TEMPO$
575 TMP(I,J)=VAL(TEMPO$):IF TEMPO$=R1$ THEN PRINT ELSE 585:INPUT R2$,COR
580  IF  TEMPO$=R1$  THEN  J=J-1  ELSE  585:TMP(I,J)=COR:IF  J=0  THEN  I=I-1  ELSE
585:J=6:TMP(I,J)=COR
585 IF (I-1)*6+J=NTS THEN J=6
590 NEXT J
595 PRINT:NEXT I
600 PRINT R3$:INPUT R$
605 IF R$=R1$ THEN INPUT R2$,COR
610 IF R$=R1$ THEN J=J-1 ELSE 615:TMP(I,J)=COR:IF J=0 THEN I=I-1 ELSE 615:J=6:TMP(I,J)=COR
615 FOR I=1 TO INT((NTS-1)/6+1)
620 FOR J=1 TO 6
625 PRINT #1,USING"  ###.#    ";TMP(I,J);
630 IF (I-1)*6+J=NTS THEN J=6
635 NEXT J
640 PRINT #1,"":NEXT I
645 FOR K=1 TO NLA
650 PRINT #1,USING"LAYER    #.";K
655 PRINT:PRINT"MODULI IN SPECIFIED TIME INTERVALS FOR LAYER NO. ";K:PRINT
660 FOR I=1 TO INT((NTS-1)/6+1)
665 FOR J=1 TO 6
670 INPUT TEMPOR
675 MDS(K,I,J)=TEMPOR:IF TEMPOR=81 THEN PRINT ELSE 685:INPUT R2$,COR
680  IF  TEMPOR=81  THEN  J=J-1  ELSE  685:MDS(K,I,J)=COR:IF  J=0  THEN  I=I-1  ELSE
685:J=6:MDS(K,I,J)=COR
685 IF (I-1)*6+J=NTS THEN J=6
690 NEXT J
695 PRINT:NEXT I
700 PRINT R3$:INPUT R$
705 IF R$=R1$ THEN INPUT R2$,COR
710  IF  R$=R1$  THEN  J=J-1  ELSE  715:MDS(K,I,J)=COR:IF  J=0  THEN  I=I-1  ELSE
```

```
715:J=6:MDS(K,I,J)=COR
715 FOR I=1 TO INT((NTS-1)/6+1)
720 FOR J=1 TO 6
725 PRINT #1,USING" ##########. ";MDS(K,I,J);
730 IF (I-1)*6+J=NTS THEN J=6
735 NEXT J
740 PRINT #1,"":NEXT I
745 NEXT K
750 PRINT #1,"VARCOEF"
755 PRINT:PRINT"COEFFICIENTS OF VARIATION IN LAYER MODULI, IN SPECIFIED TIME INTERVALS
(SEASONS):":PRINT
760 FOR I=1 TO INT((NTS-1)/6+1)
765 FOR J=1 TO 6
770 INPUT TEMPO$
775 CEV(I,J)=VAL(TEMPO$):IF TEMPO$=R1$ THEN PRINT ELSE 785:INPUT R2$,COR
780 IF TEMPO$=R1$ THEN J=J-1 ELSE 785:CEV(I,J)=COR:IF J=0 THEN I=I-1 ELSE
785:J=6:CEV(I,J)=COR
785 IF (I-1)*6+J=NTS THEN J=6
790 NEXT J
795 PRINT:NEXT I
800 PRINT R3$:INPUT R$
805 IF R$=R1$ THEN INPUT R2$,COR
810 IF R$=R1$ THEN J=J-1 ELSE 815:CEV(I,J)=COR:IF J=0 THEN I=I-1 ELSE 815:J=6:CEV(I,J)=COR
815 FOR I=1 TO INT((NTS-1)/6+1)
820 FOR J=1 TO 6
825 PRINT #1,USING" .## ";CEV(I,J);
830 IF (I-1)*6+J=NTS THEN J=6
835 NEXT J
840 PRINT #1,"":NEXT I
845 PRINT #1,"STRNEXP"
850 PRINT:PRINT"DAMAGE COEFFICIENT, K2, IN SPECIFIED TIME INTERVALS (SEASONS):":PRINT
855 FOR I=1 TO INT((NTS-1)/6+1)
860 FOR J=1 TO 6
865 INPUT TEMPO$
870 K2C(I,J)=VAL(TEMPO$):IF TEMPO$=R1$ THEN PRINT ELSE 880:INPUT R2$,COR
875 IF TEMPO$=R1$ THEN J=J-1 ELSE 880:K2C(I,J)=COR:IF J=0 THEN I=I-1 ELSE
880:J=6:K2C(I,J)=COR
880 IF (I-1)*6+J=NTS THEN J=6
885 NEXT J
890 PRINT:NEXT I
891 PRINT R3$:INPUT R$
892 IF R$=R1$ THEN INPUT R2$,COR
893 IF R$=R1$ THEN J=J-1 ELSE 895:K2C(I,J)=COR:IF J=0 THEN I=I-1 ELSE 895:J=6:K2C(I,J)=COR
895 FOR I=1 TO INT((NTS-1)/6+1)
900 FOR J=1 TO 6
905 PRINT #1,USING" #.## ";K2C(I,J);
910 IF (I-1)*6+J=NTS THEN J=6
912 NEXT J
915 PRINT #1,"":NEXT I
920 PRINT #1,"STRNCOEF"
925 PRINT:PRINT"DAMAGE COEFFICIENT, K1, IN SPECIFIED TIME INTERVALS (SEASONS):":PRINT
930 FOR I=1 TO INT((NTS-1)/6+1)
935 FOR J=1 TO 6
940 INPUT TEMPO$
945 K1C(I,J)=VAL(TEMPO$):IF TEMPO$=R1$ THEN PRINT ELSE 955:INPUT R2$,COR
950 IF TEMPO$=R1$ THEN J=J-1 ELSE 955:K1C(I,J)=COR:IF J=0 THEN I=I-1 ELSE
```

```
955:J=6:K1C(I,J)=COR
955 IF (I-1)*6+J=NTS THEN J=6
960 NEXT J
965 PRINT:NEXT I
966 PRINT R3$:INPUT R$
967 IF R$=R1$ THEN INPUT R2$,COR
968 IF R$=R1$ THEN J=J-1 ELSE 970:K1C(I,J)=COR:IF J=0 THEN I=I-1 ELSE 970:J=6:K1C(I,J)=COR
970 FOR I=1 TO INT((NTS-1)/6+1)
975 FOR J=1 TO 6
980 PRINT #1,USING"    #.#^^^^";K1C(I,J);
985 IF (I-1)*6+J=NTS THEN J=6
987 NEXT J
990 PRINT #1,"":NEXT I
995 PRINT:INPUT"COEFFICIENT OF VARIATION FOR K1: ",TEMP$
1000 DE=0!:GOSUB 2950
1005 CV1=DE:IF TEMP$=R1$ THEN CV1=COR
1010 INPUT"COEFFICIENT OF VARIATION FOR K2: ",TEMP$
1015 DE=0!:GOSUB 2950
1020 CV2=DE:IF TEMP$=R1$ THEN CV2=COR
1025 INPUT"CORRELATION COEFFICIENT BETWEEN K1 AND K2: ",TEMP$
1030 DE=0!:GOSUB 2950
1035 K1K2=DE:IF TEMP$=R1$ THEN K1K2=COR
1040 PRINT #1,USING"COEFK1    .##     COEFK2       .## K1K2CORL    +.###";CV1;CV2;K1K2
1045 FOR K=1 TO NLA
1050 PRINT #1,USING"GNU    #.";K
1055 PRINT:PRINT"FRACTIONAL DIFFERENCES IN CREEP COMPLIANCE FUNCTION FOR LAYER NO.
";K:PRINT
1060 FOR I=1 TO INT((NTS-1)/6+1)
1065 FOR J=1 TO 6
1070 INPUT TEMPOR
1075 CCG(K,I,J)=TEMPOR:IF TEMPOR=01 THEN PRINT ELSE 1085:INPUT R2$,COR
1080 IF TEMPOR=01 THEN J=J-1 ELSE 1085:CCG(K,I,J)=COR:IF J=0 THEN I=I-1 ELSE
1085:J=6:CCG(K,I,J)=COR
1085 IF (I-1)*6+J=NTS THEN J=6
1090 NEXT J
1095 PRINT:NEXT I
1100 PRINT R3$:INPUT R$
1105 IF R$=R1$ THEN INPUT R2$,COR
1110 IF R$=R1$ THEN J=J-1 ELSE 1115:CCG(K,I,J)=COR:IF J=0 THEN I=I-1 ELSE
1115:J=6:CCG(K,I,J)=COR
1115 FOR I=1 TO INT((NTS-1)/6+1)
1120 FOR J=1 TO 6
1125 PRINT #1,USING"  .####  ";CCG(K,I,J);
1130 IF (I-1)*6+J=NTS THEN J=6
1135 NEXT J
1140 PRINT #1,"":NEXT I
1145 PRINT #1,USING"ALPHA    #.";K
1150 PRINT:PRINT"EXPONENTS IN CREEP COMPLIANCE FUNCTION FOR LAYER NO. ";K:PRINT
1155 FOR I=1 TO INT((NTS-1)/6+1)
1160 FOR J=1 TO 6
1165 INPUT TEMPOR
1170 CCA(K,I,J)=TEMPOR:IF TEMPOR=01 THEN PRINT ELSE 1180:INPUT R2$,COR
1175 IF TEMPOR=01 THEN J=J-1 ELSE 1180:CCA(K,I,J)=COR:IF J=0 THEN I=I-1 ELSE
1180:J=6:CCA(K,I,J)=COR
1180 IF (I-1)*6+J=NTS THEN J=6
1185 NEXT J
```

```
1190 PRINT:NEXT I
1195 PRINT R3$:INPUT R$
1200 IF R$=R1$ THEN INPUT R2$,COR
1205 IF R$=R1$ THEN J=J-1 ELSE 1210:CCA(K,I,J)=COR:IF J=0 THEN I=I-1 ELSE
1210:J=6:CCA(K,I,J)=COR
1310 FOR I=1 TO INT((NTS-1)/6+1)
1215 FOR J=1 TO 6
1220 PRINT #1,USING" .##    ";CCA(K,I,J);
1225 IF (I-1)*6+J=NTS THEN J=6
1230 NEXT J
1235 PRINT #1,"":NEXT I
1240 NEXT K
1245 PRINT:INPUT"COEFFICIENT B IN THE SYSTEM'S SPACIAL AUTOCORRELATION FUNCTION:
",TEMP$
1250 DE=0!:GOSUB 2950
1255 CFB=DE:IF TEMP$=R1$ THEN CFB=COR
1260 INPUT"PART OF THE EXPONENT IN THE SYSTEM'S SPACIAL AUTOCORRELATION FUNCTION:
",TEMP$
1265 DE=1!:GOSUB 2950
1270 CFC=DE:IF TEMP$=R1$ THEN CFC=COR
1275 PRINT #1,USING"CORLCOEF #.###    CORLEXP #.###";CFB;CFC
1280 PRINT:INPUT"NUMBER OF POINTS USED IN REPEATED LOAD ANALYSIS (max.25): ",TEMP$
1285 DE=1!:GOSUB 2950
1290 PRL=DE:IF TEMP$=R1$ THEN PRL=COR
1295 PRINT #1,USING"NTRANDOM      ##.";PRL
1300 PRINT #1,"TRANDOM"
1305 PRINT:PRINT"TIMES AT WHICH YOU WISH VALUES COMPUTED IN DAMAGE MODEL TO BE
PRINTED OUT:"
1310 FOR I=1 TO INT((PRL-1)/6+1)
1315 FOR J=1 TO 6
1320 INPUT TEMPO$
1325 TDR(I,J)=VAL(TEMPO$):IF TEMPO$=R1$ THEN PRINT ELSE 1335:INPUT R2$,COR
1330 IF TEMPO$=R1$ THEN J=J-1 ELSE 1335:TDR(I,J)=COR:IF J=0 THEN I=I-1 ELSE
1335:J=6:TDR(I,J)=COR
1335 IF (I-1)*6+J=PRL THEN J=6
1340 NEXT J
1345 PRINT:NEXT I
1350 PRINT R3$:INPUT R$
1355 IF R$=R1$ THEN INPUT R2$,COR
1360 IF R$=R1$ THEN J=J-1 ELSE 1365:TDR(I,J)=COR:IF J=0 THEN I=I-1 ELSE 1365:
J=6:TDR(I,J)=COR
1365 FOR I=1 TO INT((PRL-1)/6+1)
1370 FOR J=1 TO 6
1375 PRINT #1,USING" ####.    ";TDR(I,J);
1380 IF (I-1)*6+J=PRL THEN J=6
1385 NEXT J
1390 PRINT #1,"":NEXT I
1395 PRINT:INPUT"UNIT OF TIME TO BE USED IN DAMAGE MODEL (..4=days, 5=months, 6=years):
",TEMP$
1400 DE=6!:GOSUB 2950
1405 TIU=DE:IF TEMP$=R1$ THEN TIU=COR
1410 PRINT #1,USING"TUNITS      #.";TIU
1415 PRINT #1,"LAMBDA"
1420 PRINT"AVERAGE DAILY TRAFFIC AT SPECIFIED POINTS IN TIME:"
1425 FOR I=1 TO INT((PRL-1)/6+1)
1430 FOR J=1 TO 6
```

```
1435 INPUT TEMPO$
1440 ADT(I,J)=VAL(TEMPO$):IF TEMPO$=R1$ THEN PRINT ELSE 1450:INPUT R2$,COR
1445 IF TEMPO$=R1$ THEN J=J-1 ELSE 1450:ADT(I,J)=COR:IF J=0 THEN I=I-1 ELSE
1450:J=6:ADT(I,J)=COR
1450 IF (I-1)*6+J=PRL THEN J=6
1455 NEXT J
1460 PRINT:NEXT I
1465 PRINT R3$:INPUT R$
1470 IF R$=R1$ THEN INPUT R2$,COR
1475 IF R$=R1$ THEN J=J-1 ELSE 1480:ADT(I,J)=COR:IF J=0 THEN I=I-1 ELSE
1480:J=6:ADT(I,J)=COR
1480 FOR I=1 TO INT((PRL-1)/6+1)
1485 FOR J=1 TO 6
1490 PRINT #1,USING" #####.   ";ADT(I,J);
1495 IF (I-1)*6+J=PRL THEN J=6
1500 NEXT J
1505 PRINT #1,"":NEXT I
1510 PRINT:INPUT"MEAN LOAD INTENSITY OF REPEATED LOADINGS (psi): ",TEMP$
1515 DE=80!:GOSUB 2950
1520 MRL=DE:IF TEMP$=R1$ THEN MRL=COR
1525 INPUT"VARIANCE OF REPEATED LOAD INTENSITY DISTRIBUTION: ",TEMP$
1530 DE=4000!:GOSUB 2950
1535 VLD=DE:IF TEMP$=R1$ THEN VLD=COR
1540 PRINT #1,USING"AMPLITUD    ###.#  VCAMP      ##.#";MRL;VLD
1545 PRINT:INPUT"MEAN VALUE OF SERVIC.INDEX DISTRIBUTION AT THE START OF REPEATED
LOAD ANALYSIS: ",TEMP$
1550 DE=5!:GOSUB 2950
1555 SIM=DE:IF TEMP$=R1$ THEN SIM=COR
1560 INPUT"STANDARD DEV. OF INITIAL SERVIC.INDEX IN PERFORMANCE MODEL: ",TEMP$
1565 DE=0!:GOSUB 2950
1570 SISD=DE:IF TEMP$=R2$ THEN SISD=COR
1575 PRINT #1,USING"QUALITY0      #.#  STDEV0      ##.#";SIM;SISD
1580 PRINT #1,"ENDOFRUN"
1585 REM
1590 PRINT:GOTO 3000
2900 REM Set Up Messages & Text Window
2915 H$="INPUT YOUR NEW DATA WHERE PROMPTED"
2920 L$=STRING$(80,CHR$(42))
2930 M$="PRESS <SPACE> TO SCROLL, <ENTER> TO END"
2940 N$="TYPE <XX> IF NO CHANGE INTENDED, <ZZZ> TO QUIT DATA INPUT"
2950 P$="TYPE <-999> TO REPLACE LAST INPUT ITEM"
2960 LOCATE 2,1:PRINT SPC((80-LEN(TITLE$))/2);TITLE$
2965 LOCATE 4,1:PRINT SPC((80-LEN(H$))/2);H$
2970 PRINT:PRINT L$:LOCATE 20,1:PRINT L$
2980 PRINT SPC((80-LEN(M$))/2);M$
2990 PRINT SPC((80-LEN(N$))/2);N$
2995 PRINT SPC((80-LEN(P$))/2);P$
2900 VIEW PRINT 7 TO 19
2910 RETURN
2940 REM S u b r o u t i n e  1
2950 IF VAL(TEMP$)<>DE THEN DE=VAL(TEMP$)
2955 IF TEMP$="XX"THEN RETURN
2960 IF TEMP$="-999" THEN INPUT R2$,COR
2962 IF TEMP$="ZZZ" THEN PRINT ELSE 2965:CLOSE #1:GOTO 9030
2965 RETURN
3000 REM
```

```
3010 PRINT #1,"ENDOFJOB"
3020 CLOSE #1
3025 PRINT R46
3030 END
3050 INPUT"File Name OK (Y/N) ";R$
3055 IF R$<>"Y" THEN GOTO 3060
3057 CLOSE:GOTO 60
3060 RESUME 90
```

INPUT DATA

(VESYS3-A-M)

```
TITLE
LOOP 4 SECTION 581
TYPE      1.
UNLOAD    15.
RADIUS          6.18
ZCRACK         5.0
NRPOINTS          2.
RPOINTS
    0.            5.
NZPOINTS          4.
ZPOINTS
    0.            5.           11.           23.
NLAYER          4.
THICK
   5.           6.           12.
POISSON
   .33          .4           .4           .4
NTEMPS          4.
TEMPS
   51.0          69.0         96.0          73.0

LAYER     1.
  1600000.    550000.     140000.       450000.
LAYER     2.
    40000.     30000.      40000.        40000.
LAYER     3.
    20000.     15000.      20000.        20000.
LAYER     4.
     4500.      3000.       4500.         4500.

VARCOEF
   .1           .15          .15           .2
STRNEXP
  5.1          5.01         4.87          4.99
STRNCOEF
     1.0E-13      1.6E-12      1.3E-08      3.0E-12
COEFK1      .3        COEFK2            .04 K1K2CORL      -.867

GNU       1.
   .04          .0780        .1            .082
ALPHA     1.
   .6           .72          .6            .71
GNU       2.
   .04          .075         .2            .11
ALPHA     2.
   .75          .75          .75           .75
```

```
GNU       3.
   .0048          .024          .0133          .0083
ALPHA     3.
   .75            .75           .75            .75
GNU       4.
   .04            .15           .04            .04
ALPHA     4.
   .75            .75           .75            .75

CORLCOEF 1.          CORLEXP   .058

NTRANDOM          25.
TRANDOM
   22.          45.           68.           91.          122.          152.
   183.         213.          243.          274.         304.          335.
   365.         395.          426.          456.         487.          517.
   548.         578.          608.          639.         669.          700.
   730.
TUNITS            4.
LAMBDA
   800.         800.          800.          800.         647.          647.
   647.         1195.         1195.         1195.        1195.         1195.
   1195.        1830.         1830.         1830.        2356.         2356.
   2356.        2290.         2290.         2290.        1896.         1896.
   1896.

AMPLITUD          75.   VCAMP          0.0
QUALITY0           4.2  STDEV0         0.0
ENDOFRUN
ENDOFJOB
```

FHWA
PREDICTIVE DESIGN PROCEDURES

VESYS III : A PROBABILISTIC PREDICTIVE MODEL FOR PAVEMENT DESIGN

LATEST REVISION: JUNE 1987, MASS INST OF TECH

********** I N P U T **********

```
LOOP 4 SECTION 581
INPUT DATA VALUES FOR RUN      1
     >>>> TYPE                 1
     >>>> UNLOAD              15

          LOADING     .1000E+01
     >>>> RADIUS      .6180E+01
     >>>> NRPOINTS           2
     >>>> ICRACK      .5000E+01
     >>>> RPOINTS
             .0000E+00   .5000E+01
     >>>> NZPOINTS           4
     >>>> ZPOINTS
             .0000E+00   .5000E+01   .1100E+02   .2300E+02
     >>>> NLAYER            4
     >>>> THICK
             .5000E+01   .6000E+01   .1200E+02
     >>>> POISSON
             .3300E+00   .4000E+00   .4000E+00   .4000E+00
     >>>> LAYER             1
             .1600E+07   .5500E+06   .1400E+06   .4500E+06
     >>>> LAYER             2
             .4000E+05   .3000E+05   .4000E+05   .4000E+05
     >>>> LAYER             3
             .2000E+05   .1500E+05   .2000E+05   .2000E+05
     >>>> LAYER             4
             .4500E+04   .3000E+04   .4500E+04   .4500E+04
     >>>> VARCOEF
             .1000E+00   .1500E+00   .1500E+00   .2000E+00
     >>>> STRNEXP
             .5100E+01   .5010E+01   .4870E+01   .4990E+01
     >>>> STRNCOEF
             .1000E-12   .1600E-11   .1300E-07   .3000E-11
     >>>> COEFK1      .3000E+00
     >>>> COEFK2      .4000E-01
     >>>> K1K2CORL  -.8670E+00
     >>>> NTEMPS            4
     >>>> TEMPS
             .5100E+02   .6900E+02   .9600E+02   .7300E+02
     >>>> GNU         LAYER  1
             .4000E-01   .7800E-01   .1000E+00   .8200E-01
     >>>> ALPHA       LAYER  1
```

```
        .6000E+00   .7200E+00   .6000E+00   .7100E+00
>>>> GNU          LAYER  2
        .4000E-01   .7500E-01   .2000E+00   .1100E+00
>>>> ALPHA        LAYER  2
        .7500E+00   .7500E+00   .7500E+00   .7500E+00
>>>> GNU          LAYER  3
        .4800E-02   .2400E-01   .1330E-01   .8300E-02
>>>> ALPHA        LAYER  3
        .7500E+00   .7500E+00   .7500E+00   .7500E+00
>>>> GNU          LAYER  4
        .4000E-01   .1500E+00   .4000E-01   .4000E-01
>>>> ALPHA        LAYER  4
        .7500E+00   .7500E+00   .7500E+00   .7500E+00

>>>> CORLCOEF    .1000E+01
>>>> CORLEXP     .5800E-01

>>>> NTRANDOM          25
>>>> TRANDOM
        .2200E+02   .4500E+02   .6800E+02   .9100E+02   .1220E+03   .1520E+03   .1830E+03   .2130E+03   .2430E+03   .2740E+03
        .3040E+03   .3350E+03   .3650E+03   .3950E+03   .4260E+03   .4560E+03   .4870E+03   .5170E+03   .5480E+03   .5780E+03
        .6080E+03   .6390E+03   .6690E+03   .7000E+03   .7300E+03
>>>> TUNITS             4
>>>> LAMBDA
        .8000E+03   .8000E+03   .8000E+03   .8000E+03   .6470E+03   .6470E+03   .6470E+03   .1195E+04   .1195E+04   .1195E+04
        .1195E+04   .1195E+04   .1195E+04   .1830E+04   .1830E+04   .1830E+04   .2356E+04   .2356E+04   .2356E+04   .2290E+04
        .2290E+04   .2290E+04   .1896E+04   .1896E+04   .1896E+04
     TRAFMULT
        .1000E+01   .1000E+01   .1000E+01   .1000E+01
     LOADDIST
        .1000E+01


>>>> AMPLITUD    .7500E+02
>>>> VCAMP       .0000E+00
     DURATION    .5000E-01


>>>> QUALITY0    .4200E+01
>>>> STDEV0      .0000E+00
     PSIFAIL     .2500E+01
     TOLERNCE    .5000E+02


     WINTTEMP    .0000E+00
     STIFF       .0000E+00
     SUBGTYPE    .2000E+01
```

********** O U T P U T **********

********** LOOP 4 SECTION 581 **********

PROBLEM PARAMETERS SOLUTION NUMBER 1

TOTAL LOAD (LBS)	119.98
TIRE PRESSURE (PSI)	1.00
LOAD RADIUS (IN)	6.18

LAYER 1 - MODULUS	1600000.	POISSON'S RATIO	.330	THICKNESS (IN)	5.00
LAYER 2 - MODULUS	40000.	POISSON'S RATIO	.400	THICKNESS (IN)	6.00
LAYER 3 - MODULUS	20000.	POISSON'S RATIO	.400	THICKNESS (IN)	12.00
LAYER 4 - MODULUS	4500.	POISSON'S RATIO	.400	SEMI-INFINITE THICKNESS	

PROBABLISTIC PARAMETERS

LAYER 1--COEFFICIENT OF VARIATION OF MODULUS	10.00 %
LAYER 2--COEFFICIENT OF VARIATION OF MODULUS	15.00 %
LAYER 3--COEFFICIENT OF VARIATION OF MODULUS	15.00 %
LAYER 4--COEFFICIENT OF VARIATION OF MODULUS	20.00 %

STRESSES

		VERTICAL		TANGENTIAL		RADIAL		SHEAR		
R	Z	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	ITG
.00	.00	-.100E+01	.000E+00	-.426E+01	.173E+00	-.426E+01	.173E+00	.000E+00	.000E+00	4
.00	5.00	-.163E+00	.147E-01	.365E+01	.202E+00	.365E+01	.202E+00	.000E+00	.000E+00	4
.00	11.00	-.722E-01	.611E-02	.778E-01	.263E-01	.778E-01	.263E-01	.000E+00	.000E+00	4
.00	23.00	-.216E-01	.264E-02	.515E-01	.111E-01	.515E-01	.111E-01	.000E+00	.000E+00	4
5.00	.00	-.816E+00	.000E+00	-.364E+01	.161E+00	-.325E+01	.153E+00	.000E+00	.000E+00	4
5.00	5.00	-.129E+00	.103E-01	.300E+01	.184E+00	.256E+01	.173E+00	-.462E-01	.681E-02	4
5.00	11.00	-.637E-01	.511E-02	.713E-01	.238E-01	.650E-01	.226E-01	-.178E-01	.203E-02	4
5.00	23.00	-.209E-01	.251E-02	.496E-01	.107E-01	.483E-01	.105E-01	-.241E-02	.366E-03	4

********** LOOP 4 SECTION 581 **********

DISPLACEMENTS

		VERTICAL		RADIAL		STRAINS: RADIAL		TANGENTIAL		
R	Z	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	ITG
.00	.00	.314E-03	.386E-04	.000E+00	.000E+00	-.158E-05	.195E-06	-.158E-05	.195E-06	4
.00	5.00	.312E-03	.386E-04	.000E+00	.000E+00	.156E-05	.205E-06	.156E-05	.205E-06	4
.00	11.00	.291E-03	.383E-04	.000E+00	.000E+00	.189E-05	.766E-06	.189E-05	.766E-06	4
.00	23.00	.253E-03	.372E-04	.000E+00	.000E+00	.198E-05	.671E-06	.198E-05	.671E-06	4

5.00	.00	.304E-03	.384E-04	-.717E-05	.522E-06	-.111E-05	.150E-06	-.143E-05	.178E-06	4
5.00	5.00	.303E-03	.384E-04	.687E-05	.488E-06	.101E-05	.153E-06	.137E-05	.183E-06	4
5.00	11.00	.286E-03	.381E-04	.885E-05	.894E-06	.155E-05	.657E-06	.177E-05	.691E-06	4
5.00	23.00	.250E-03	.370E-04	.965E-05	.875E-06	.184E-05	.633E-06	.193E-05	.646E-06	4

PERMANENT DEFORMATION
SYSTEM RESPONSE FACTORS

TEMPERATURE (DEG F) 51.00
LOAD RADIUS (IN) 6.18

GNU = .1129E+00
ALPHA = .3033E+00

********** LOOP 4 SECTION 581 **********

PROBLEM PARAMETERS SOLUTION NUMBER 2

TOTAL LOAD (LBS) 119.98
TIRE PRESSURE (PSI) 1.00
LOAD RADIUS (IN) 6.18

LAYER 1 - MODULUS	550000.	POISSON'S RATIO	.330	THICKNESS (IN)	5.00
LAYER 2 - MODULUS	30000.	POISSON'S RATIO	.400	THICKNESS (IN)	6.00
LAYER 3 - MODULUS	15000.	POISSON'S RATIO	.400	THICKNESS (IN)	12.00
LAYER 4 - MODULUS	3000.	POISSON'S RATIO	.400	SEMI-INFINITE THICKNESS	

PROBABLISTIC PARAMETERS

LAYER 1--COEFFICIENT OF VARIATION OF MODULUS	10.00 %
LAYER 2--COEFFICIENT OF VARIATION OF MODULUS	15.00 %
LAYER 3--COEFFICIENT OF VARIATION OF MODULUS	15.00 %
LAYER 4--COEFFICIENT OF VARIATION OF MODULUS	20.00 %

STRESSES

		VERTICAL		TANGENTIAL		RADIAL		SHEAR		
R	Z	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	ITG
.00	.00	-.100E+01	.000E+00	-.334E+01	.160E+00	-.334E+01	.160E+00	.000E+00	.000E+00	4
.00	5.00	-.257E+00	.206E-01	.256E+01	.200E+00	.256E+01	.200E+00	.000E+00	.000E+00	4
.00	11.00	-.103E+00	.828E-02	.113E+00	.373E-01	.113E+00	.373E-01	.000E+00	.000E+00	4
.00	23.00	-.248E-01	.313E-02	.713E-01	.138E-01	.713E-01	.138E-01	.000E+00	.000E+00	4
5.00	.00	-.816E+00	.000E+00	-.280E+01	.143E+00	-.247E+01	.131E+00	.000E+00	.000E+00	4
5.00	5.00	-.194E+00	.133E-01	.203E+01	.172E+00	.165E+01	.156E+00	-.788E-01	.105E-01	4
5.00	11.00	-.878E-01	.661E-02	.101E+00	.329E-01	.903E-01	.308E-01	-.282E-01	.290E-02	4
5.00	23.00	-.238E-01	.296E-02	.682E-01	.132E-01	.661E-01	.129E-01	-.308E-02	.476E-03	4

********** LOOP 4 SECTION 581 **********

		DISPLACEMENTS				STRAINS				
		VERTICAL		RADIAL		RADIAL		TANGENTIAL		
R	Z	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	ITG
.00	.00	.513E-03	.805E-04	.000E+00	.000E+00	-.347E-05	.463E-06	-.347E-05	.463E-06	4
.00	5.00	.509E-03	.605E-04	.000E+00	.000E+00	.327E-05	.503E-06	.327E-05	.503E-06	4
.00	11.00	.467E-03	.597E-04	.000E+00	.000E+00	.363E-05	.145E-05	.363E-05	.145E-05	4
.00	23.00	.398E-03	.576E-04	.000E+00	.000E+00	.351E-05	.113E-05	.351E-05	.113E-05	4
5.00	.00	.492E-03	.599E-04	-.156E-04	.109E-05	-.232E-05	.344E-06	-.312E-05	.413E-06	4
5.00	5.00	.489E-03	.600E-04	.140E-04	.101E-05	.191E-05	.357E-06	.281E-05	.431E-06	4
5.00	11.00	.456E-03	.593E-04	.167E-04	.169E-05	.283E-05	.120E-05	.335E-05	.128E-05	4
5.00	23.00	.393E-03	.573E-04	.171E-04	.151E-05	.322E-05	.105E-05	.341E-05	.108E-05	4

PERMANENT DEFORMATION
SYSTEM RESPONSE FACTORS

TEMPERATURE (DEG F) 69.00
LOAD RADIUS (IN) 6.18

GNU = .4327E+00
ALPHA = .2532E+00

********** LOOP 4 SECTION 581 **********

PROBLEM PARAMETERS SOLUTION NUMBER 3

TOTAL LOAD (LBS) 119.98
TIRE PRESSURE (PSI) 1.00
LOAD RADIUS (IN) 6.18

LAYER 1 - MODULUS 140000. POISSON'S RATIO .330 THICKNESS (IN) 5.00
LAYER 2 - MODULUS 40000. POISSON'S RATIO .400 THICKNESS (IN) 6.00
LAYER 3 - MODULUS 20000. POISSON'S RATIO .400 THICKNESS (IN) 12.00
LAYER 4 - MODULUS 4500. POISSON'S RATIO .400 SEMI-INFINITE THICKNESS

PROBABLISTIC PARAMETERS

LAYER 1--COEFFICIENT OF VARIATION OF MODULUS 10.00 %
LAYER 2--COEFFICIENT OF VARIATION OF MODULUS 15.00 %
LAYER 3--COEFFICIENT OF VARIATION OF MODULUS 15.00 %
LAYER 4--COEFFICIENT OF VARIATION OF MODULUS 20.00 %

		STRESSES								
		VERTICAL		TANGENTIAL		RADIAL		SHEAR		
R	Z	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	MEAN	DEVIATION	ITG
.00	.00	-.100E+01	.000E+00	-.172E+01	.104E+00	-.172E+01	.104E+00	.000E+00	.000E+00	4
.00	5.00	-.533E+00	.256E-01	.644E+00	.142E+00	.644E+00	.142E+00	.000E+00	.000E+00	4

.00	11.00	-.188E+00	.137E-01	.172E+00	.579E-01	.172E+00	.579E-01	.000E+00	.000E+00	4
.00	23.00	-.368E-01	.463E-02	.927E-01	.186E-01	.927E-01	.186E-01	.000E+00	.000E+00	4
5.00	.00	-.816E+00	.000E+00	-.142E+01	.817E-01	-.125E+01	.681E-01	.000E+00	.000E+00	4
5.00	5.00	-.360E+00	.138E-01	.462E+00	.105E+00	.281E+00	.846E-01	-.173E+00	.143E-01	4
5.00	11.00	-.149E+00	.100E-01	.145E+00	.479E-01	.117E+00	.437E-01	-.559E-01	.488E-02	4
5.00	23.00	-.346E-01	.427E-02	.870E-01	.174E-01	.832E-01	.169E-01	-.545E-02	.811E-03	4

********** LOOP 4 SECTION 581 **********

D I S P L A C E M E N T S

		VERTICAL		RADIAL	
R	Z	MEAN	DEVIATION	MEAN	DEVIATION
.00	.00	.470E-03	.488E-04	.000E+00	.000E+00
.00	5.00	.452E-03	.488E-04	.000E+00	.000E+00
.00	11.00	.396E-03	.475E-04	.000E+00	.000E+00
.00	23.00	.318E-03	.450E-04	.000E+00	.000E+00
5.00	.00	.431E-03	.476E-04	-.265E-04	.184E-05
5.00	5.00	.419E-03	.478E-04	.174E-04	.207E-05
5.00	11.00	.379E-03	.469E-04	.197E-04	.206E-05
5.00	23.00	.312E-03	.446E-04	.169E-04	.160E-05

S T R A I N S

RADIAL		TANGENTIAL		
MEAN	DEVIATION	MEAN	DEVIATION	ITG
-.586E-05	.979E-06	-.586E-05	.979E-06	4
.434E-05	.115E-05	.434E-05	.115E-05	4
.446E-05	.170E-05	.446E-05	.170E-05	4
.352E-05	.113E-05	.352E-05	.113E-05	4
-.363E-05	.636E-06	-.529E-05	.804E-06	4
.177E-05	.677E-06	.349E-05	.850E-06	4
.297E-05	.128E-05	.393E-05	.141E-05	4
.311E-05	.103E-05	.338E-05	.107E-05	4

PERMANENT DEFORMATION
SYSTEM RESPONSE FACTORS

TEMPERATURE (DEG F) 96.00
LOAD RADIUS (IN) 6.18

GNU = .2312E+00
ALPHA = .3051E+00

********** LOOP 4 SECTION 581 **********

PROBLEM PARAMETERS SOLUTION NUMBER 4

TOTAL LOAD (LBS)	119.98
TIRE PRESSURE (PSI)	1.00
LOAD RADIUS (IN)	6.18

LAYER 1 - MODULUS	450000.	POISSON'S RATIO	.330	THICKNESS (IN)	5.00
LAYER 2 - MODULUS	40000.	POISSON'S RATIO	.400	THICKNESS (IN)	6.00
LAYER 3 - MODULUS	20000.	POISSON'S RATIO	.400	THICKNESS (IN)	12.00
LAYER 4 - MODULUS	4500.	POISSON'S RATIO	.400	SEMI-INFINITE THICKNESS	

PROBABLISTIC PARAMETERS

LAYER 1--COEFFICIENT OF VARIATION OF MODULUS	10.00 %
LAYER 2--COEFFICIENT OF VARIATION OF MODULUS	15.00 %
LAYER 3--COEFFICIENT OF VARIATION OF MODULUS	15.00 %
LAYER 4--COEFFICIENT OF VARIATION OF MODULUS	20.00 %

STRESSES

R	Z	VERTICAL MEAN	VERTICAL DEVIATION	TANGENTIAL MEAN	TANGENTIAL DEVIATION	RADIAL MEAN	RADIAL DEVIATION	SHEAR MEAN	SHEAR DEVIATION	ITG
.00	.00	-.100E+01	.000E+00	-.277E+01	.146E+00	-.277E+01	.146E+00	.000E+00	.000E+00	4
.00	5.00	-.331E+00	.237E-01	.190E+01	.189E+00	.190E+01	.189E+00	.000E+00	.000E+00	4
.00	11.00	-.127E+00	.986E-02	.131E+00	.436E-01	.131E+00	.436E-01	.000E+00	.000E+00	4
.00	23.00	-.296E-01	.373E-02	.748E-01	.153E-01	.748E-01	.153E-01	.000E+00	.000E+00	4
5.00	.00	-.816E+00	.000E+00	-.230E+01	.125E+00	-.201E+01	.112E+00	.000E+00	.000E+00	4
5.00	5.00	-.242E+00	.144E-01	.146E+01	.156E+00	.114E+01	.137E+00	-.104E+00	.127E-01	4
5.00	11.00	-.107E+00	.767E-02	.115E+00	.377E-01	.999E-01	.351E-01	-.357E-01	.347E-02	4
5.00	23.00	-.282E-01	.349E-02	.711E-01	.145E-01	.686E-01	.141E-01	-.397E-02	.594E-03	4

********** LOOP 4 SECTION 58 **********

DISPLACEMENTS

R	Z	VERTICAL MEAN	VERTICAL DEVIATION	RADIAL MEAN	RADIAL DEVIATION	ITG
.00	.00	.390E-03	.436E-04	.000E+00	.000E+00	4
.00	5.00	.385E-03	.436E-04	.000E+00	.000E+00	4
.00	11.00	.347E-03	.428E-04	.000E+00	.000E+00	4
.00	23.00	.287E-03	.410E-04	.000E+00	.000E+00	4
5.00	.00	.369E-03	.431E-04	-.152E-04	.105E-05	4
5.00	5.00	.366E-03	.431E-04	.130E-04	.100E-05	4
5.00	11.00	.336E-03	.425E-04	.147E-04	.148E-05	4
5.00	23.00	.283E-03	.408E-04	.137E-04	.126E-05	4

STRAINS

R	Z	RADIAL MEAN	RADIAL DEVIATION	TANGENTIAL MEAN	TANGENTIAL DEVIATION	ITG
.00	.00	-.340E-05	.482E-06	-.340E-05	.482E-06	4
.00	5.00	.308E-05	.539E-06	.308E-05	.539E-06	4
.00	11.00	.323E-05	.127E-05	.323E-05	.127E-05	4
.00	23.00	.284E-05	.929E-06	.284E-05	.929E-06	4
5.00	.00	-.218E-05	.344E-06	-.304E-05	.420E-06	4
5.00	5.00	.164E-05	.365E-06	.259E-05	.444E-06	4
5.00	11.00	.241E-05	.102E-05	.295E-05	.110E-05	4
5.00	23.00	.257E-05	.859E-06	.275E-05	.883E-06	4

PERMANENT DEFORMATION
SYSTEM RESPONSE FACTORS

TEMPERATURE (DEG F) 73.00
LOAD RADIUS (IN) 6.18

GNU = .1933E+00
ALPHA = .2612E+00

FATIGUE CRACKING

GENERAL STRAIN RESPONSE DUE TO PEAK LOADING (HAVERSINE)

TEMPERATURE DEGREES-F	STRAIN INS./IN.	VAR STRAIN (INS./IN.)**2	NFAIL CYCLES	VAR NFAIL CYCLES**2	K1 CYCLES	K2 DIMENSIONLESS	GAMMA DIMENSIONLESS
FOR RADIUS = 6.18 INCHES							
51.00	.11721E-03	.23655E-09	.69763E+07	.11183E+14	.10000E-12	.51000E+01	.00000E+00
69.00	.24541E-03	.14242E-08	.13534E+07	.42578E+12	.16000E-11	.50100E+01	.00000E+00

96.00	.32547E-03	.74877E-08	.76720E+09	.13644E+18	.13000E-07	.48700E+01	.00000E+00
73.00	.23083E-03	.16348E-08	.28184E+07	.18439E+13	.30000E-11	.49900E+01	.00000E+00

FATIGUE CRACKING			LOW TEMP CRACKING		AREA CRACKED SQ.YDS/1000 SQ.YDS		
DAMAGE INDEX DIMENSIONLESS	VAR DAMAGE INDEX DIMENSIONLESS	TIME MONTHS	CRACKING INDEX	AVG. CRACK SPACING, FT.	FATIGUE	LO TEMP	TOTAL
.39285E-02	.35692E-04	22.00	.00	.0	.0	.0	.0
.80356E-02	.73006E-04	45.00	.00	.0	.0	.0	.0
.12143E-01	.11032E-03	68.00	.00	.0	.0	.0	.0
.16250E-01	.14763E-03	91.00	.00	.0	.0	.0	.0
.39500E-01	.10784E-02	122.00	.00	.0	.0	.0	.0
.62175E-01	.19877E-02	152.00	.00	.0	.0	.0	.0
.85323E-01	.29160E-02	183.00	.00	.0	.0	.0	.0
.85397E-01	.29160E-02	213.00	.00	.0	.0	.0	.0
.85471E-01	.29161E-02	243.00	.00	.0	.0	.0	.0
.85588E-01	.29175E-02	274.00	.00	.0	.0	.0	.0
.10566E+00	.36265E-02	304.00	.00	.0	.0	.0	.0
.12640E+00	.43591E-02	335.00	.00	.0	.0	.0	.0
.14648E+00	.50681E-02	365.00	.00	.0	.0	.0	.0
.15880E+00	.53265E-02	395.00	.00	.0	.0	.0	.0
.17146E+00	.55897E-02	426.00	.00	.0	.0	.0	.0
.18371E+00	.58444E-02	456.00	.00	.0	.0	.0	.0
.26772E+00	.18083E-01	487.00	.00	.0	.0	.0	.0
.35029E+00	.30141E-01	517.00	.00	.0	.1	.0	.1
.43526E+00	.42551E-01	548.00	.00	.0	3.1	.0	3.1
.43540E+00	.42551E-01	578.00	.00	.0	3.1	.0	3.1
.43555E+00	.42551E-01	608.00	.00	.0	3.1	.0	3.1
.43569E+00	.42551E-01	639.00	.00	.0	3.1	.0	3.1
.46734E+00	.44324E-01	669.00	.00	.0	5.7	.0	5.7
.50025E+00	.46168E-01	700.00	.00	.0	10.0	.0	10.0
.53210E+00	.47953E-01	730.00	.00	.0	16.3	.0	16.3

R U T D E P T H

PERMANENT DEFORMATION
SYSTEM RESPONSE FACTORS

GENERAL DEFLECTION RESPONSE DUE TO PEAK LOADING (HAVERSINE)

TEMPERATURE DEGREES F	DEFLECTION INCHES	VAR DEFLECTION INCHES**2	GNU DIMENSIONLESS	ALPHA DIMENSIONLESS
FOR RADIUS = 6.18 INCHES				
51.00	.2351E-01	.8400E-05	.113	.303
69.00	.3844E-01	.2056E-04	.433	.253
96.00	.3524E-01	.1339E-04	.231	.305
73.00	.2925E-01	.1070E-04	.193	.261

RUT DEPTH INCHES	VAR RUT DEPTH INCHES**2	TIME MONTHS
.19110E-01	.23010E-04	22.00

.39088E-01	.47066E-04	45.00
.59066E-01	.71122E-04	68.00
.79044E-01	.95178E-04	91.00
.14320E+00	.40252E-03	122.00
.20558E+00	.70212E-03	152.00
.26938E+00	.10080E-02	183.00
.29264E+00	.10862E-02	213.00
.31590E+00	.11644E-02	243.00
.33974E+00	.12452E-02	274.00
.34023E+00	.13150E-02	304.00
.34073E+00	.13872E-02	335.00
.34122E+00	.14571E-02	365.00
.34185E+00	.15661E-02	395.00
.34250E+00	.16787E-02	426.00
.34313E+00	.17876E-02	456.00
.37153E+00	.20422E-02	487.00
.39924E+00	.22897E-02	517.00
.42771E+00	.25412E-02	548.00
.44566E+00	.25293E-02	578.00
.46361E+00	.25174E-02	608.00
.48201E+00	.25063E-02	639.00
.48230E+00	.26421E-02	669.00
.48260E+00	.27823E-02	700.00
.48289E+00	.29181E-02	730.00

R O U G H N E S S

SLOPE VARIANCE RADIANS*10**6	VAR SLOPE VARIANCE (RADIANS*10**6)**2	TIME MONTHS
.30232E-02	.20387E-05	22.00
.12266E-01	.17447E-04	45.00
.27725E-01	.60202E-04	68.00
.49401E-01	.14428E-03	91.00
.16284E+00	.20026E-02	122.00
.33461E+00	.71994E-02	152.00
.57302E+00	.17748E-01	183.00
.67543E+00	.22569E-01	213.00
.78626E+00	.28192E-01	243.00
.90863E+00	.34870E-01	274.00
.91176E+00	.36932E-01	304.00
.91501E+00	.39076E-01	335.00
.91816E+00	.41162E-01	365.00
.92235E+00	.44403E-01	395.00
.92669E+00	.47777E-01	426.00
.93089E+00	.51066E-01	456.00
.10910E+01	.68397E-01	487.00
.12592E+01	.88550E-01	517.00
.14445E+01	.11279E+00	548.00
.15665E+01	.12188E+00	578.00
.16935E+01	.13127E+00	608.00
.18290E+01	.14128E+00	639.00
.18322E+01	.14911E+00	669.00
.18355E+01	.15722E+00	700.00
.18388E+01	.16509E+00	730.00

P E R F O R M A N C E

RUT DEPTH	VAR RUT DEPTH	SLOPE VAR	VAR SLOPE VAR	CRACKING	VAR CRACKING	TIME
.19110E-01	.23010E-04	.30232E-02	.20387E-05	.39285E-02	.35692E-04	22.00
.39088E-01	.47066E-04	.12266E-01	.17447E-04	.80356E-02	.73006E-04	45.00
.59066E-01	.71122E-04	.27725E-01	.60202E-04	.12143E-01	.11032E-03	68.00
.79044E-01	.95178E-04	.49401E-01	.14428E-03	.16250E-01	.14763E-03	91.00
.14320E+00	.40252E-03	.16284E+00	.20026E-02	.39500E-01	.10784E-02	122.00
.20558E+00	.70212E-03	.33461E+00	.71994E-02	.62175E-01	.19877E-02	152.00
.26938E+00	.10080E-02	.57302E+00	.17748E-01	.85323E-01	.29160E-02	183.00
.29264E+00	.10862E-02	.67543E+00	.22569E-01	.85397E-01	.29160E-02	213.00
.31590E+00	.11644E-02	.78626E+00	.28192E-01	.85471E-01	.29161E-02	243.00
.33974E+00	.12452E-02	.90863E+00	.34870E-01	.85588E-01	.29175E-02	274.00
.34023E+00	.13150E-02	.91176E+00	.36932E-01	.10566E+00	.36265E-02	304.00
.34073E+00	.13872E-02	.91501E+00	.39076E-01	.12640E+00	.43591E-02	335.00
.34122E+00	.14571E-02	.91816E+00	.41162E-01	.14648E+00	.50681E-02	365.00
.34185E+00	.15661E-02	.92235E+00	.44403E-01	.15880E+00	.53265E-02	395.00
.34250E+00	.16787E-02	.92669E+00	.47777E-01	.17146E+00	.55897E-02	426.00
.34313E+00	.17876E-02	.93089E+00	.51066E-01	.18371E+00	.58444E-02	456.00
.37153E+00	.20422E-02	.10910E+01	.68397E-01	.26772E+00	.18083E-01	487.00
.39924E+00	.22897E-02	.12592E+01	.88550E-01	.35029E+00	.30141E-01	517.00
.42771E+00	.25412E-02	.14445E+01	.11279E+00	.43526E+00	.42551E-01	548.00
.44566E+00	.25293E-02	.15665E+01	.12188E+00	.43540E+00	.42551E-01	578.00
.46361E+00	.25174E-02	.16935E+01	.13127E+00	.43555E+00	.42551E-01	608.00
.48201E+00	.25063E-02	.18290E+01	.14128E+00	.43569E+00	.42551E-01	639.00
.48230E+00	.26421E-02	.18322E+01	.14911E+00	.46734E+00	.44324E-01	669.00
.48260E+00	.27823E-02	.18355E+01	.15722E+00	.50025E+00	.46168E-01	700.00
.48289E+00	.29181E-02	.18388E+01	.16509E+00	.53210E+00	.47953E-01	730.00

SERVICEABILITY	VARIANCE OF SERVICEABILITY	TIME
4.19696	.00000	22.00
4.18772	.00001	45.00
4.17243	.00004	68.00
4.15130	.00009	91.00
4.04662	.00108	122.00
3.90296	.00301	152.00
3.72568	.00549	183.00
3.65558	.00624	213.00
3.58313	.00696	243.00
3.50679	.00768	274.00
3.50509	.00811	304.00
3.50334	.00856	335.00
3.50164	.00899	365.00
3.49943	.00966	395.00
3.49715	.01036	426.00
3.49494	.01103	456.00
3.40131	.01291	487.00
3.30499	.01472	517.00
3.19284	.01653	548.00
3.13065	.01656	578.00
3.06789	.01657	608.00
3.00299	.01658	639.00
2.99562	.01747	669.00

2.98669	.01839	700.00
2.97681	.01928	730.00

SERVICEABILITY FAILURE LEVEL IS 2.50000

MARGINAL STATE PROBABILITIES

STATE UPPER BOUNDS - .1E+11 4.74889 4.46778 4.18667 3.90556 3.62444 3.34333 3.06222 2.78111 2.50000
STATE LOWER BOUNDS - 4.74889 4.46778 4.18667 3.90556 3.62444 3.34333 3.06222 2.78111 2.50000 -.1E+11

STATE1	STATE2	STATE3	STATE4	STATE5	STATE6	STATE7	STATE8	STATE9	STATE10	TIME	RELIABILITY
.00000	.00000	1.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.0	1.00000
.00000	.00000	1.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	22.0	1.00000
.00000	.00000	.61826	.38174	.00000	.00000	.00000	.00000	.00000	.00000	45.0	1.00000
.00000	.00000	.01317	.98683	.00000	.00000	.00000	.00000	.00000	.00000	68.0	1.00000
.00000	.00000	.00014	.99986	.00000	.00000	.00000	.00000	.00000	.00000	91.0	1.00000
.00000	.00000	.00001	.99998	.00001	.00000	.00000	.00000	.00000	.00000	122.0	1.00000
.00000	.00000	.00000	.48109	.51891	.00000	.00000	.00000	.00000	.00000	152.0	1.00000
.00000	.00000	.00000	.00761	.90642	.08598	.00000	.00000	.00000	.00000	183.0	1.00000
.00000	.00000	.00000	.00078	.65246	.34673	.00004	.00000	.00000	.00000	213.0	1.00000
.00000	.00000	.00000	.00006	.31024	.68767	.00203	.00000	.00000	.00000	243.0	1.00000
.00000	.00000	.00000	.00000	.08973	.87918	.03109	.00000	.00000	.00000	274.0	1.00000
.00000	.00000	.00000	.00000	.09257	.87118	.03625	.00000	.00000	.00000	304.0	1.00000
.00000	.00000	.00000	.00001	.09525	.86289	.04185	.00000	.00000	.00000	335.0	1.00000
.00000	.00000	.00000	.00001	.09762	.85488	.04749	.00000	.00000	.00000	365.0	1.00000
.00000	.00000	.00000	.00002	.10170	.84214	.05613	.00000	.00000	.00000	395.0	1.00000
.00000	.00000	.00000	.00003	.10546	.82918	.06532	.00001	.00000	.00000	426.0	1.00000
.00000	.00000	.00000	.00005	.10870	.81684	.07440	.00002	.00000	.00000	456.0	1.00000
.00000	.00000	.00000	.00000	.02478	.67028	.30351	.00142	.00000	.00000	487.0	1.00000
.00000	.00000	.00000	.00000	.00423	.37176	.60132	.02268	.00001	.00000	517.0	1.00000
.00000	.00000	.00000	.00000	.00039	.12049	.72430	.15414	.00068	.00000	548.0	1.00000
.00000	.00000	.00000	.00000	.00006	.04912	.65338	.29414	.00330	.00000	578.0	1.00000
.00000	.00000	.00000	.00000	.00001	.01618	.50136	.46951	.01295	.00001	608.0	.99999
.00000	.00000	.00000	.00000	.00000	.00411	.31867	.63479	.04239	.00005	639.0	.99995
.00000	.00000	.00000	.00000	.00000	.00426	.30292	.64050	.05222	.00009	669.0	.99991
.00000	.00000	.00000	.00000	.00000	.00427	.28449	.64646	.06461	.00017	700.0	.99983
.00000	.00000	.00000	.00000	.00000	.00415	.26508	.65142	.07906	.00030	730.0	.99970

WARNING> RELIABILITY EXCEEDS THE SPECIFIED TOLERANCE THROUGHOUT THE PERIOD OF THIS ANALYSIS. IF AN ACCURATE ESTIMATE OF SERVICE LIFE IS REQUIRED, THEN THIS RUN SHOULD BE RESUBMITTED WITH ADDITIONAL TRANDOM POINTS, EXTENDING THE ANALYSIS BEYOND THE TIME AT WHICH RELIABILITY DROPS BELOW THE MINIMUM ACCEPTABLE LEVEL.

APPENDIX E

BISAR-PC

(EXAMPLE)

EXAMPLE RUN WITH 3-LAYERS SYSTEM WITH 2 X 20 KN AXLELOAD

```
 2
 3                                                    B E G I N   S Y S T E M: 1

 .100000E+10 .350000     .200000                            SYS.: 1   layer: 1
 .100000E+09 .350000     .300000                            SYS.: 1   layer: 2
 .100000E+08 .350000                                        SYS.: 1   subgr.
 2                                                          SYS.: 1   loads: v
2222   577433.     .105000     .000000    -.157500                              1
2222   577433.     .105000     .000000     .157500

Asphalt layer 20 cm
 4                                                          SYS.: 1   posit: v
 1 .000000     .000000     .200000                        SYS.: 1   posno. 1
 1 .000000     .157500     .200000                        SYS.: 1   posno. 2
 3 .000000     .000000     .500000                        SYS.: 1   posno. 3
 3 .000000     .157500     .500000                        SYS.: 1   posno. 4


 3                                                    B E G I N   S Y S T E M: 2

 .100000E+10 .350000     .300000                            SYS.: 2   layer: 1
 .100000E+09 .350000     .300000                            SYS.: 2   layer: 2
 .100000E+08 .350000                                        SYS.: 2   subgr.
 2                                                          SYS.: 2   loads: v
2222   577433.     .105000     .000000    -.157500                              1
2222   577433.     .105000     .000000     .157500                              2

Asphalt layer 30 cm
 4                                                          SYS.: 2   posit: v
 1 .000000     .000000     .300000                        SYS.: 2   posno. 1
 1 .000000     .157500     .300000                        SYS.: 2   posno. 2
 3 .000000     .000000     .600000                        SYS.: 2   posno. 3
 3 .000000     .157500     .600000                        SYS.: 2   posno. 4
```

EXAMPLE OUTPUT WITH 3-LAYERS AND 2 x 20 KN AXLELOAD

Start time: 14:50: 6.74 DATE: 6 February 1991
Stop time: 14:50:49.97

A. DESCRIPTION OF THE SYSTEMS (Systems: 1 to 2 OF 2 Systems)

SYS.#	D E S C R I P T I O N
1	Asphalt layer 20 cm
2	Asphalt layer 30 cm

1

Page: B-1 >>This is a SHELL computer program<<

B. CHARACTERISATION OF THE CONSTRUCTIONS (Systems: 1 to 2 OF 2 Systems)

Title: EXAMPLE RUN WITH 3-LAYERS SYSTEM WITH 2 X 20 KN AXLELOAD

SYS.#	<<<< LAYER 1 >>>>	<<<< LAYER 2 >>>>	<<<< LAYER 3 >>>>	<<<< LAYER 4 >>>>
1	E-mod: 1000.0 MPa	E-mod: 100.0 MPa	E-mod: 10.0 MPa	
	Thick: .200 m	Thick: .300 m	Thick: infinite	
	PR : .35 -	PR : .35 -	PR : .35 -	
2	E-mod: 1000.0 MPa	E-mod: 100.0 MPa	E-mod: 10.0 MPa	
	Thick: .300 m	Thick: .300 m	Thick: infinite	
	PR : .35 -	PR : .35 -	PR : .35 -	

1

Page: C-1 >>This is a SHELL computer program<<

C. CHARACTERISATION OF THE LOADS (Systems: 1 to 2 OF 2 Systems)

Title: EXAMPLE RUN WITH 3-LAYERS SYSTEM WITH 2 X 20 KN AXLELOAD

SYS.#	<<<< LOAD 1 >>>>	<<<< LOAD 2 >>>>	<<<< LOAD 3 >>>>	<<<< LOAD 4 >>>>
1	LOADING (2 units)	LOADING (2 units)		
	Load: 20.0kN	Load: 20.0kN		
	Strs: 577.4kPa	Strs: 577.4kPa		
	Radius: .105 m	Radius: .105 m		
	X-coor: .000 m	X-coor: .000 m		
	Y-coor: -.157 m	Y-coor: +.157 m		
2	LOADING (2 units)	LOADING (2 units)		
	Load: 20.0kN	Load: 20.0kN		
	Strs: 577.4kPa	Strs: 577.4kPa		
	Radius: .105 m	Radius: .105 m		
	X-coor: .000 m	X-coor: .000 m		
	Y-coor: -.157 m	Y-coor: +.157 m		

1

D. POSITIONS AND RESULTS (Pos.: 1- 5) (Systems: 1 to 2 OF 2 Systems)

Title: EXAMPLE RUN WITH 3-LAYERS SYSTEM WITH 2 X 20 KN AXLELOAD

SIGN convention STRESSES and STRAINS: + = TENSILE stress or strain;
- = COMPRESSIVE stress or strain.

SYS.	POSITION 1	POSITION 2	POSITION 3	POSITION 4	POSITION 5
1	COORDINATES (m)	COORDINATES (m)	COORDINATES (m)	COORDINATES (m)	
	X-crd: .0000	X-crd: .0000	X-crd: .0000	X-crd: .0000	
	Y-crd: .0000	Y-crd: +.1575	Y-crd: .0000	Y-crd: +.1575	
	Depth: .2000	Depth: .2000	Depth: .5000	Depth: .5000	
	Layer:layer 1	Layer:layer 1	Layer:layer 3	Layer:layer 3	
	maximum STRESSES (MPa)	maximum STRESSES (MPa)	maximum STRESSES (MPa)	maximum STRESSES (MPa)	
	Hor.X: +.4881	Hor.X: +.5072	Hor.X:+.00076	Hor.X:+.00069	
	Vert.: -.0641	Vert.: -.0697	Vert.: -.0123	Vert.: -.0117	
	maximum STRAINS (um/m)	maximum STRAINS (um/m)	maximum STRAINS (um/m)	maximum STRAINS (um/m)	
	Hor.X: +397.5	Hor.X: +385.7	Hor.X: +494.1	Hor.X: +474.0	
	Vert.: -347.9	Vert.: -393.1	Vert.:-1267.3	Vert.:-1196.5	
2	COORDINATES (m)	COORDINATES (m)	COORDINATES (m)	COORDINATES (m)	
	X-crd: .0000	X-crd: .0000	X-crd: .0000	X-crd: .0000	
	Y-crd: .0000	Y-crd: +.1575	Y-crd: .0000	Y-crd: +.1575	
	Depth: .3000	Depth: .3000	Depth: .6000	Depth: .6000	
	Layer:layer 1	Layer:layer 1	Layer:layer 3	Layer:layer 3	
	maximum STRESSES (MPa)	maximum STRESSES (MPa)	maximum STRESSES (MPa)	maximum STRESSES (MPa)	
	Hor.X: +.3320	Hor.X: +.3182	Hor.X:+.00040	Hor.X:+.00036	
	Vert.: -.0348	Vert.: -.0337	Vert.: -.0076	Vert.: -.0073	
	maximum STRAINS (um/m)	maximum STRAINS (um/m)	maximum STRAINS (um/m)	maximum STRAINS (um/m)	
	Hor.X: +249.6	Hor.X: +235.7	Hor.X: +298.7	Hor.X: +289.4	
	Vert.: -245.6	Vert.: -239.3	Vert.: -782.8	Vert.: -748.6	

D. POSITIONS AND RESULTS (Pos.: 6-10) (Systems: 1 to 2 OF 2 Systems)

Title: EXAMPLE RUN WITH 3-LAYERS SYSTEM WITH 2 X 20 KN AXLELOAD

SIGN convention STRESSES and STRAINS: + = TENSILE stress or strain;
- = COMPRESSIVE stress or strain.

SYS.	POSITION 6	POSITION 7	POSITION 8	POSITION 9	POSITION 10
1	No positions over 5 specified for this system				(only 4 positions)
2	No positions over 5 specified for this system				(only 4 positions)

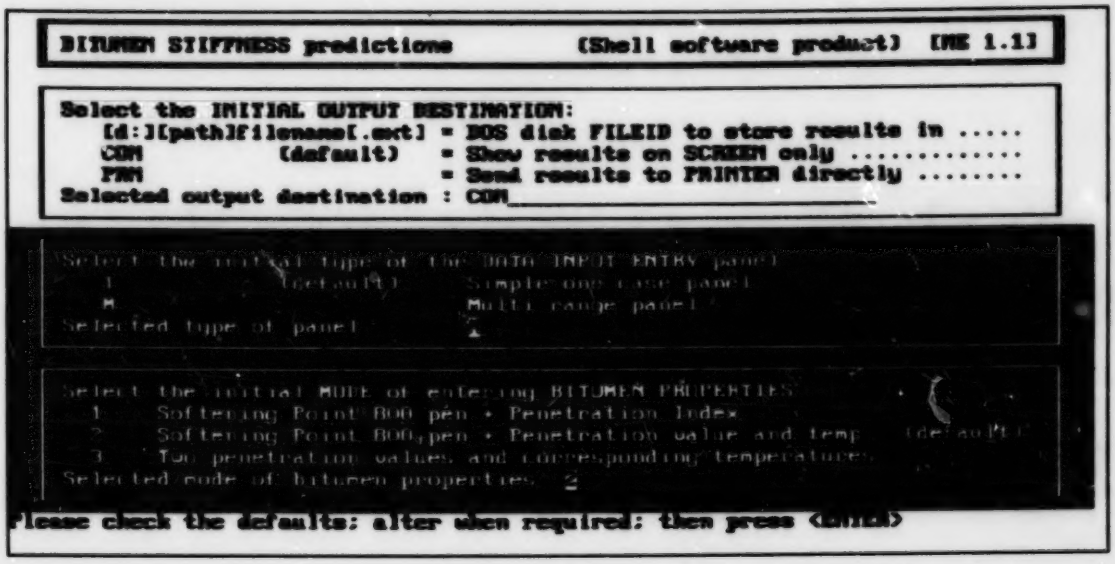
1

APPENDIX F

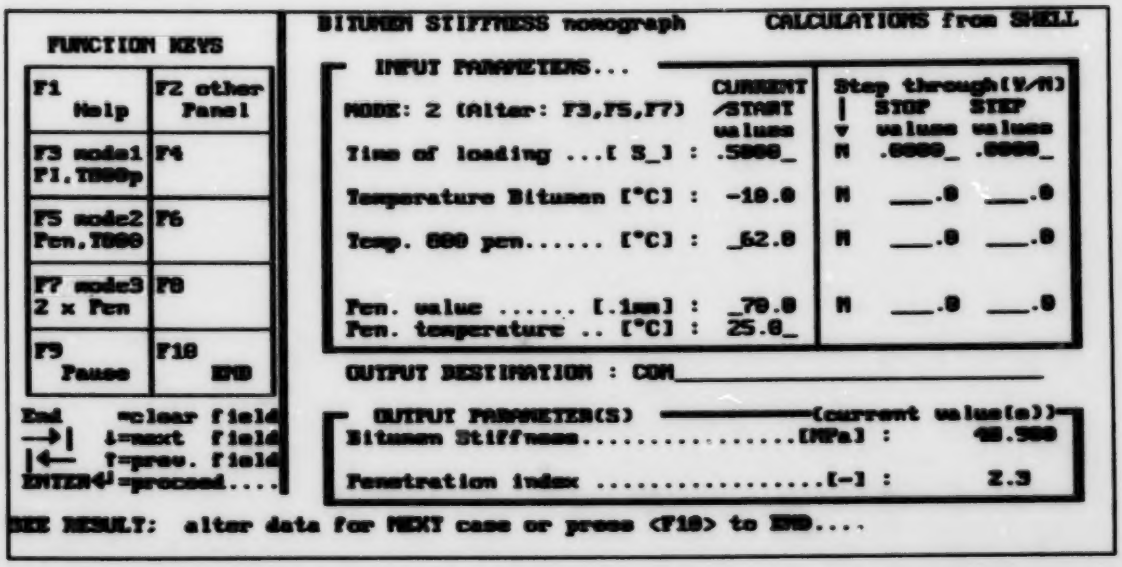
BANDS-PC

(EXAMPLE)

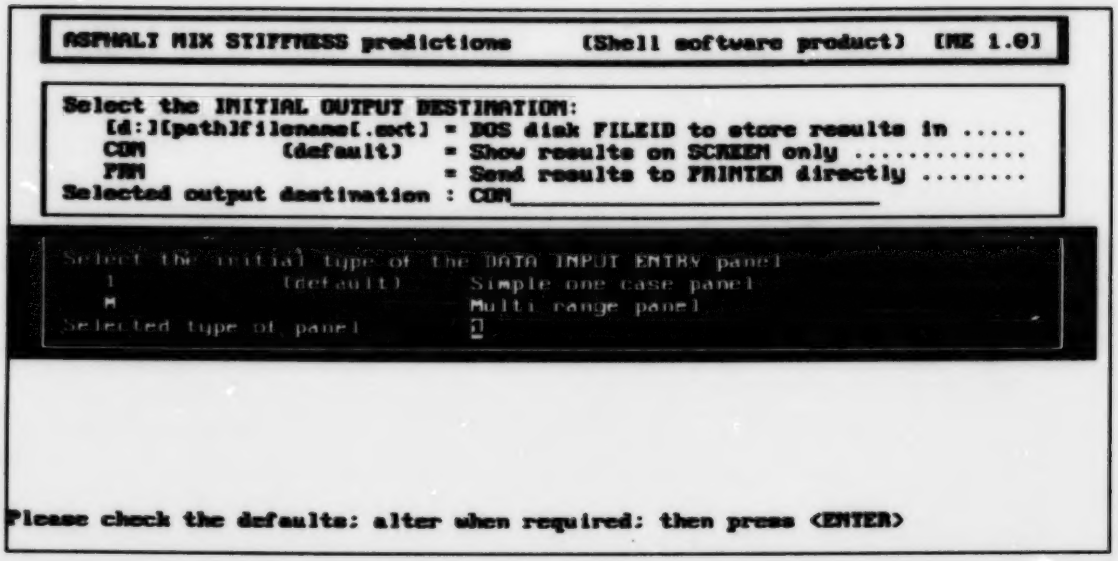
BITUMEN STIFFNESS PREDICTION: OPTION SELECTION SCREEN


BITUMEN STIFFNESS predictions (Shell software product) [ME 1.1]
Select the INITIAL OUTPUT DESTINATION:
[d:][path]filename[.ext] = DOS disk FILEID to store results in .....
CON (default) = Show results on SCREEN only .....
PRN = Send results to PRINTER directly .....
Selected output destination : CON
Select the initial type of the DATA INPUT ENTRY panel
1 (default) Simple one case panel
M Multi range panel
Selected type of panel
Select the initial MODE of entering BITUMEN PROPERTIES
1 Softening Point BOB pen + Penetration Index
2 Softening Point BOB,pen + Penetration value and temp (default)
3 Two penetration values and corresponding temperatures
Selected mode of bitumen properties: 2
Please check the defaults: alter when required: then press <ENTER>

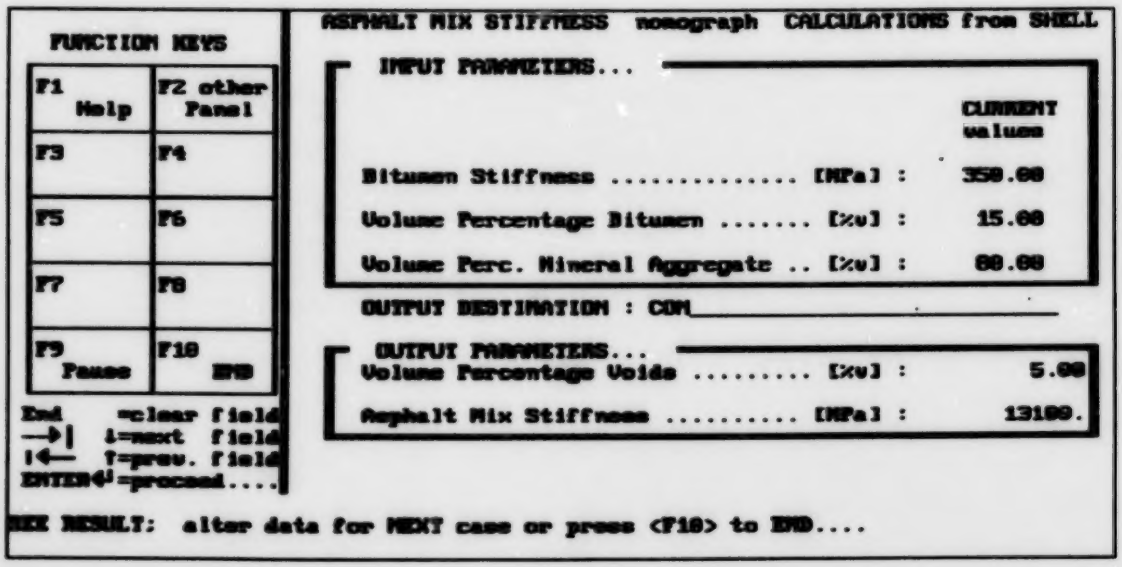
BITUMEN STIFFNESS PREDICTION: INPUT/OUTPUT SCREEN



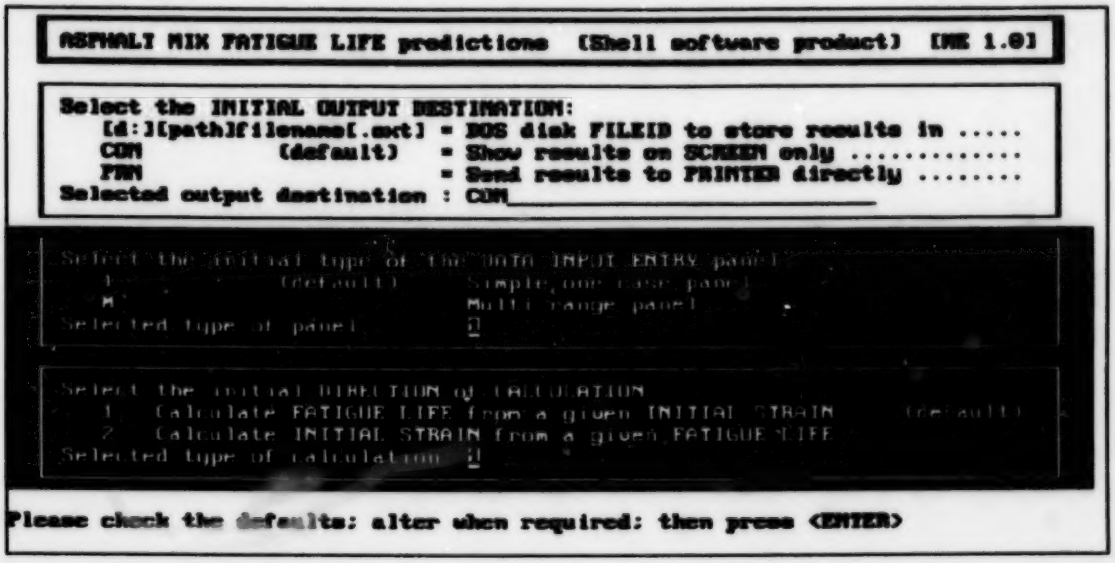
ASPHALT MIX STIFFNESS PREDICTION: OPTION SELECTION SCREEN


ASPHALT MIX STIFFNESS predictions (Shell software product) [ME 1.0]
Select the INITIAL OUTPUT DESTINATION:
[d:][path]filename[.ext] = DOS disk FILEID to store results in .....
COM (default) = Show results on SCREEN only .....
PRN = Send results to PRINTER directly .....
Selected output destination : COM
Select the initial type of the DATA INPUT ENTRY panel
1 (default) Simple one case panel
M Multi range panel
Selected type of panel : 1
Please check the defaults: alter when required: then press <ENTER>

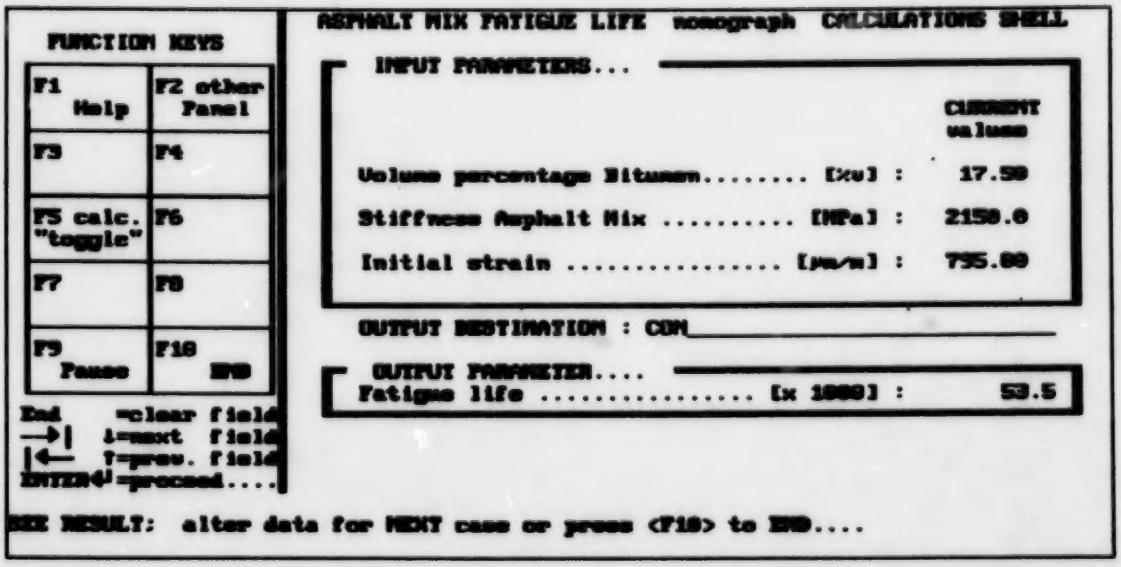
ASPHALT MIX STIFFNESS PREDICTION: INPUT/OUTPUT SCREEN



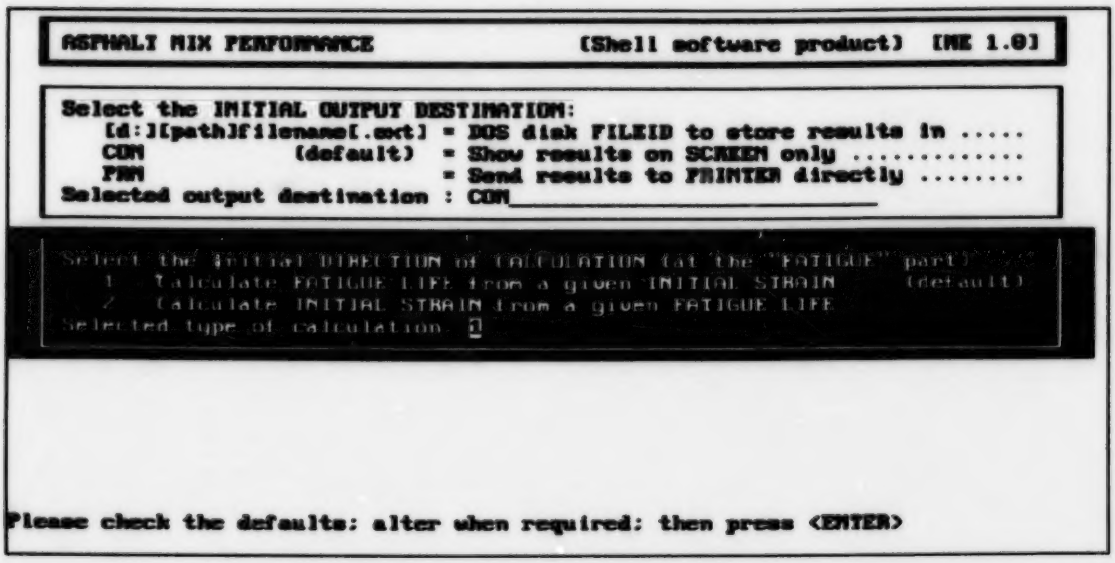
ASPHALT MIX FATIGUE LIFE PREDICTION: OPTION SELECTION SCREEN


ASPHALT MIX FATIGUE LIFE predictions (Shell software product) [ME 1.0]
Select the INITIAL OUTPUT DESTINATION:
[d:][path]filename[.ext] = DOS disk FILEID to store results in .....
CON (default) = Show results on SCREEN only .....
PRN = Send results to PRINTER directly .....
Selected output destination : CON
Select the initial type of the DATA INPUT ENTRY panel
1 (default) Simple,one case panel
M Multi range panel
Selected type of panel : 1
Select the initial DIRECTION of CALCULATION
1 Calculate FATIGUE LIFE from a given INITIAL STRAIN (default)
2 Calculate INITIAL STRAIN from a given FATIGUE LIFE
Selected type of calculation : 1
Please check the defaults: alter when required: then press <ENTER>

ASPHALT MIX FATIGUE LIFE PREDICTION: INPUT/OUTPUT SCREEN



ASPHALT MIX PERFORMANCE: OPTION SELECTION SCREEN


ASPHALT MIX PERFORMANCE (Shell software product) [ME 1.0]
Select the INITIAL OUTPUT DESTINATION:
[d:][path]filename[.ext] = DOS disk FILEID to store results in .....
CON (default) = Show results on SCREEN only .....
PRN = Send results to PRINTER directly .....
Selected output destination : CON
Select the Initial DIRECTION of CALCULATION (at the "FATIGUE" part)
1 Calculate FATIGUE LIFE from a given INITIAL STRAIN (default)
2 Calculate INITIAL STRAIN from a given FATIGUE LIFE
Selected type of calculation: 1
Please check the defaults: alter when required: then press <ENTER>

ASPHALT MIX PERFORMANCE: INPUT/OUTPUT SCREEN